Figure 3-10 shows an aircraft traverse between the two offshore sounding locations from 0941-0947 PST at a level of 168 m msl, within the ozone layer. The traverse shows ozone levels of 15 pphm or more along the entire traverse. Concentrations of 17-18 pphm were observed near the end of the traverse. Figure 3-11 shows the sounding taken at the end of the traverse. A more extensive ozone layer was present with a base of 100 m msl and a peak ozone concentration of 17 pphm. Figures 3-9 and 3-11 indicate that the ozone layer aloft did not extend to the surface and was prevented from mixing downward by the temperature inversion. In view of the southeasterly winds observed at Loyola-Marymount and the relatively high ozone concentrations observed offshore, it is suggested that this pollutant material originated in the South Coast Air Basin and was transported to the sounding locations by the southeasterly winds.

Figures 3-12 and 3-13 show soundings made in the late morning at Westlake Reservoir and Simi. There are no indications of ozone increases at any level in these soundings. Simi reported a surface ozone concentration of 6 pphm for the hour during which the Simi sounding was made. Although Camarillo and the offshore locations had experienced increases in ozone since the early morning flight, none appeared at the inland areas.

Figures 3-14 and 3-15 show the soundings at Camarillo and at the near-shore offshore location during mid-afternoon. The Camarillo sounding represents approximately the time when high surface ozone concentrations were observed in the coastal plain of Ventura County. The mixed layer at Camarillo had increased in depth to slightly over 250 m msl which was sufficient to incorporate all of the ozone layer aloft which was observed over the water. Surface heating over the land thus resulted in the elimination of the shallow, unmixed layer over the water and in the uniformly mixed layer shown in Figure 3-14. Offshore the layer continued with a depth of 250 m msl, but with a peak concentration which had increased to 25 pphm.

Figure 3-16 is a traverse between the two offshore sounding locations at 152 m msl. The data indicate that the ozone layer offshore was extensive, decreasing somewhat near the end of the traverse. This is further illustrated in Figure 3-17 which shows the sounding at the end of the traverse for which the peak ozone concentration observed was only 21 pphm at 150 m msl. The data suggest that the highest concentrations offshore were somewhat closer to the coast than was observed in the late morning.

Figures 3-18 and 3-19 show the soundings made at Westlake Reservoir and Simi during the mid-afternoon flight. These soundings were made prior to the arrival of the second ozone peak identified in Figure 3-3. Ozone concentrations in the low layers had increased from the late morning sounding and appear to be representative of conditions near the first ozone peak (Figure 3-3).

The assumed trajectory of the offshore ozone cloud is summarized in Figure 3-20. This trajectory has been estimated for parcels arriving at El Rio at the time of maximum surface concentration. Elevated and surface trajectories are contrasted in the figure. Because of the shallow nature of the ozone layer, supporting winds for the trajectory from the offshore locations to Camarillo do not exist. The trajectory has been constructed under the assumption that the offshore ozone concentrations are the only likely source of the later ozone peak which was observed in the Ventura coastal plain as well as inland.

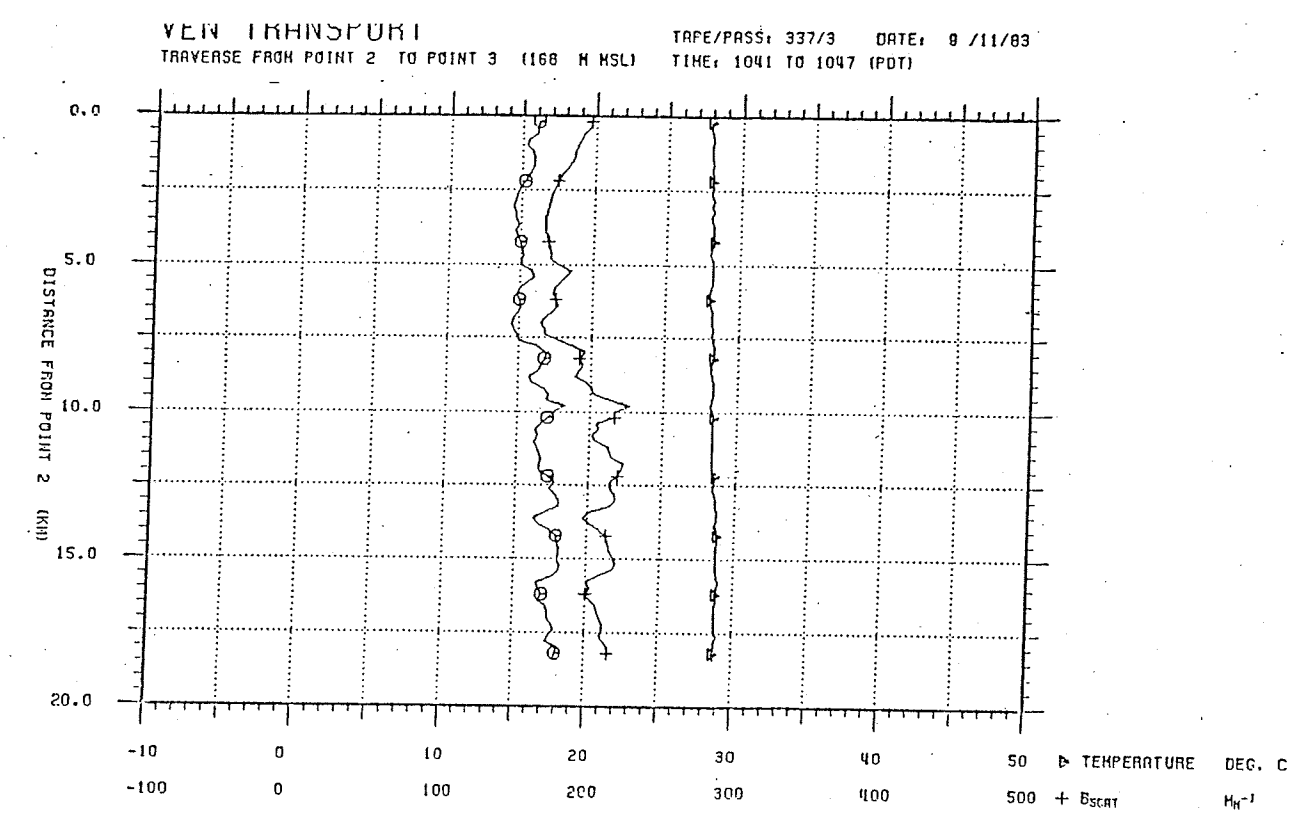

Figure 3-10. Traverse from Shoreline near Laguna Peak to 10 Miles South of Pt. Mugu at 0941 PST on September 11, 1983.

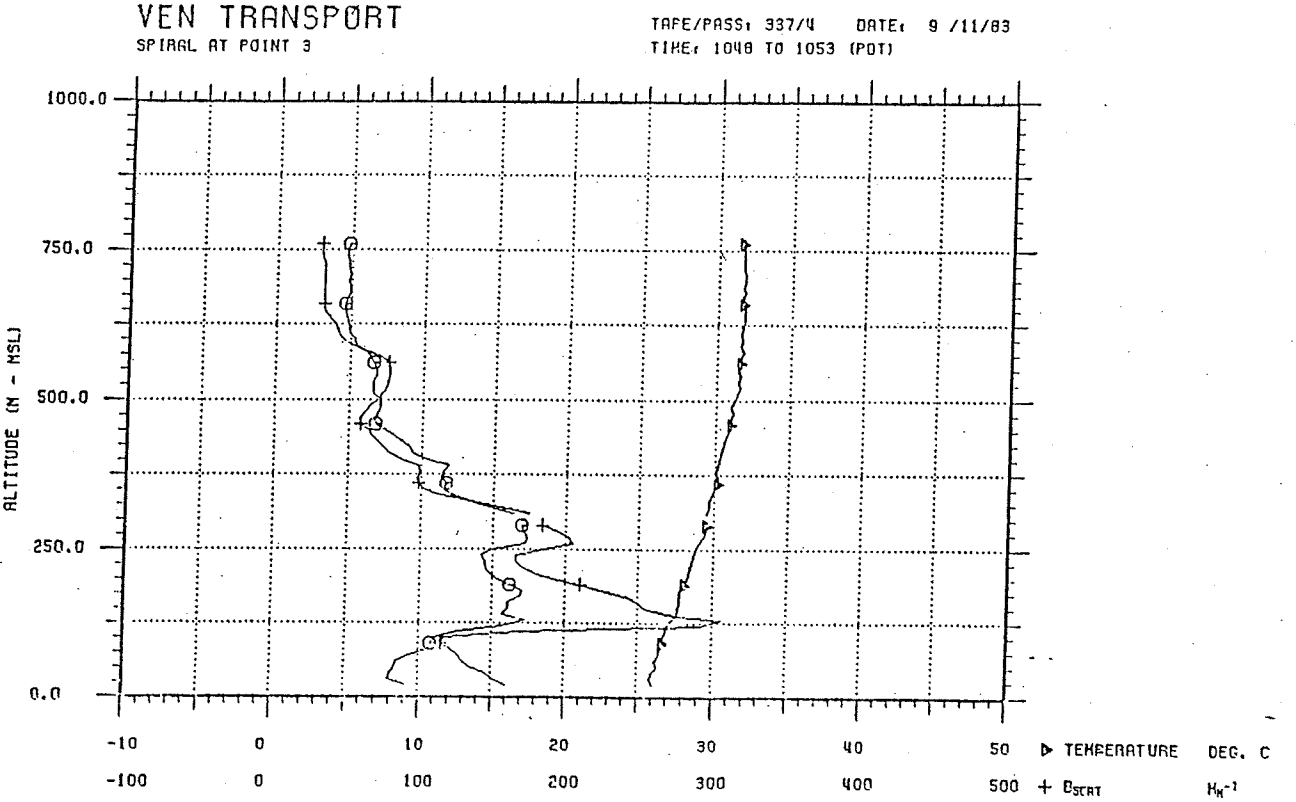

Figure 3-11. Spiral at 10 Miles South of Pt. Mugu at 0948 PST on September 11, 1983.

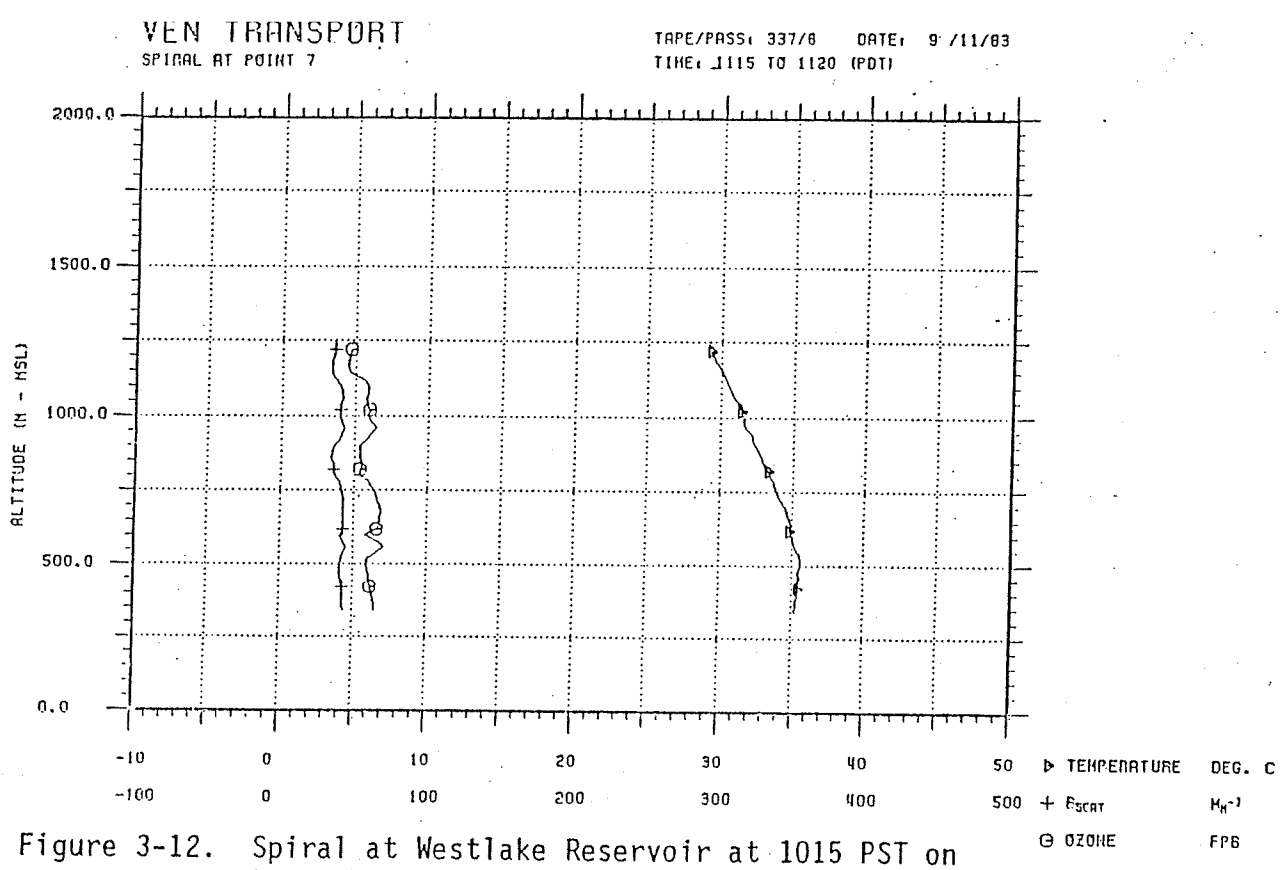

Figure 3-12. Spiral at Westlake Reservoir at 1015 PST on September 11, 1983.

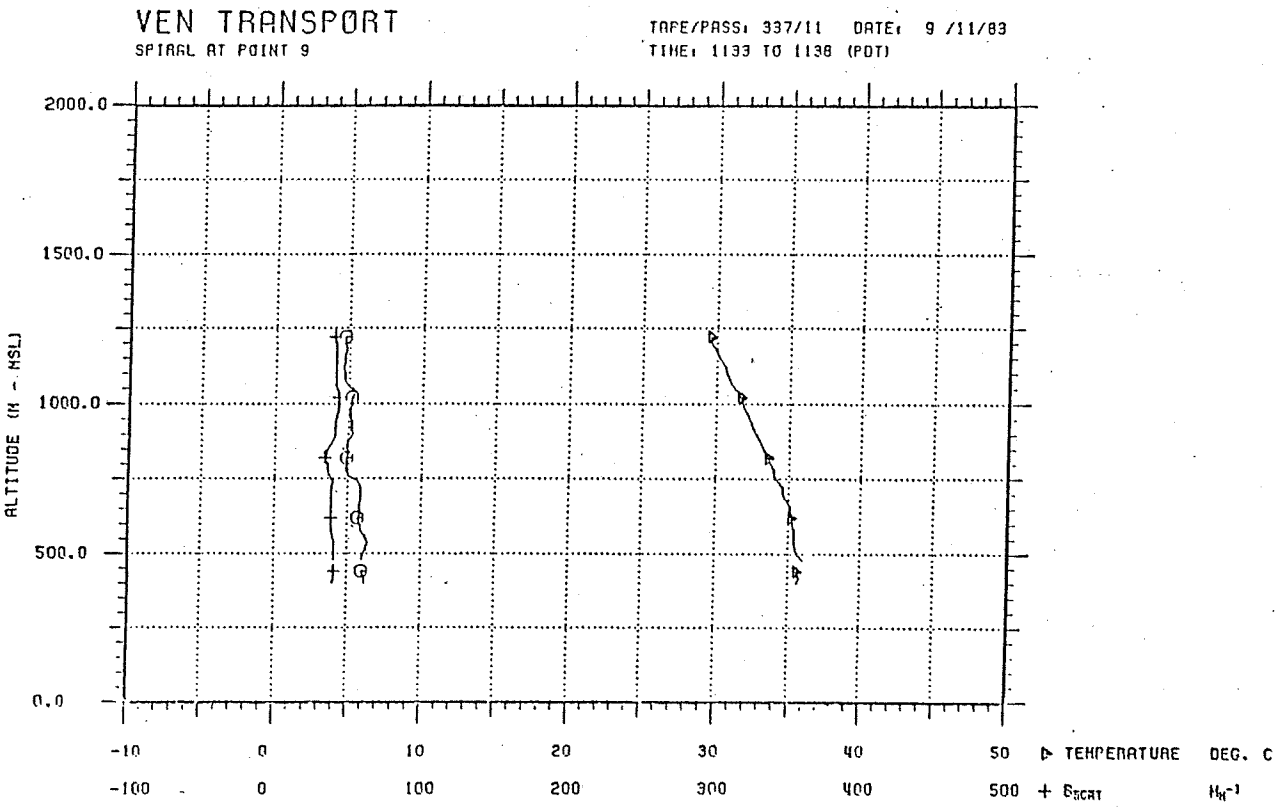

Figure 3-13. Spiral at Simi at 1033 PST on September 11, 1983.

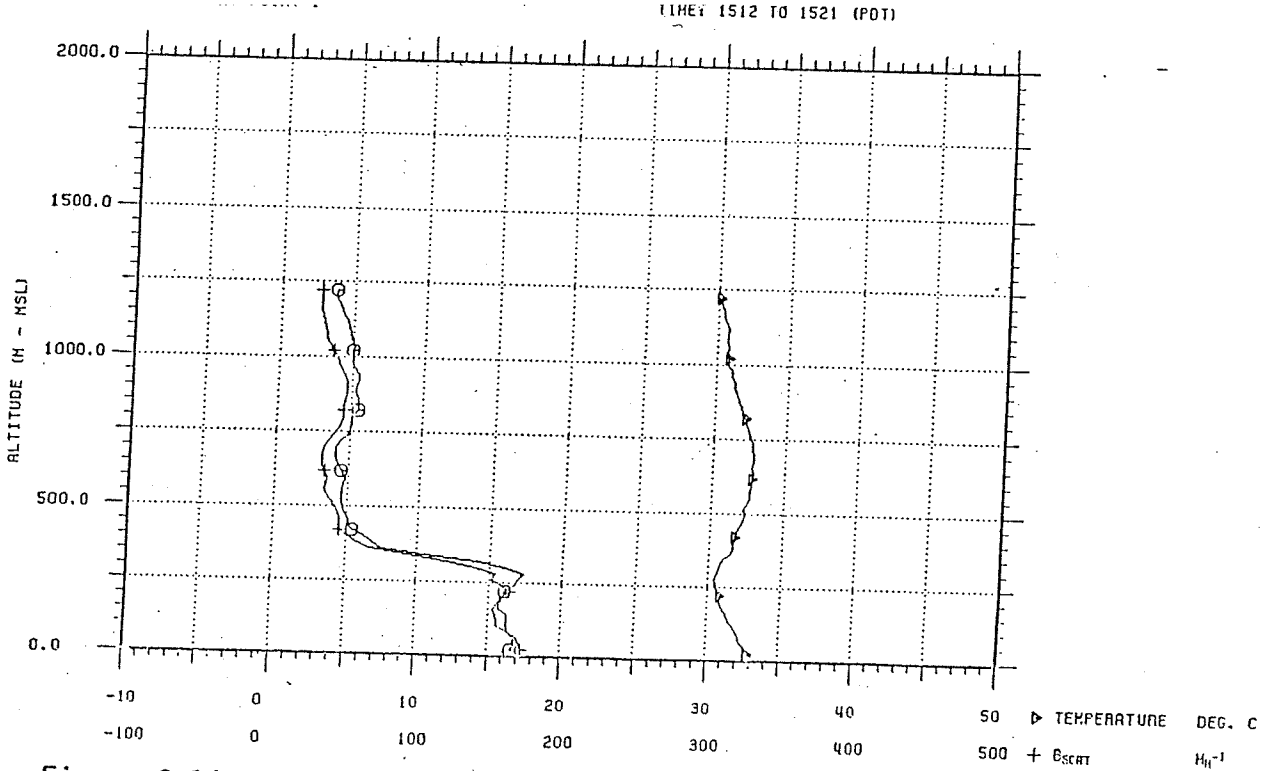

Figure 3-14. Spiral at Camarillo Airport at 1412 PST on September 11, 1983.

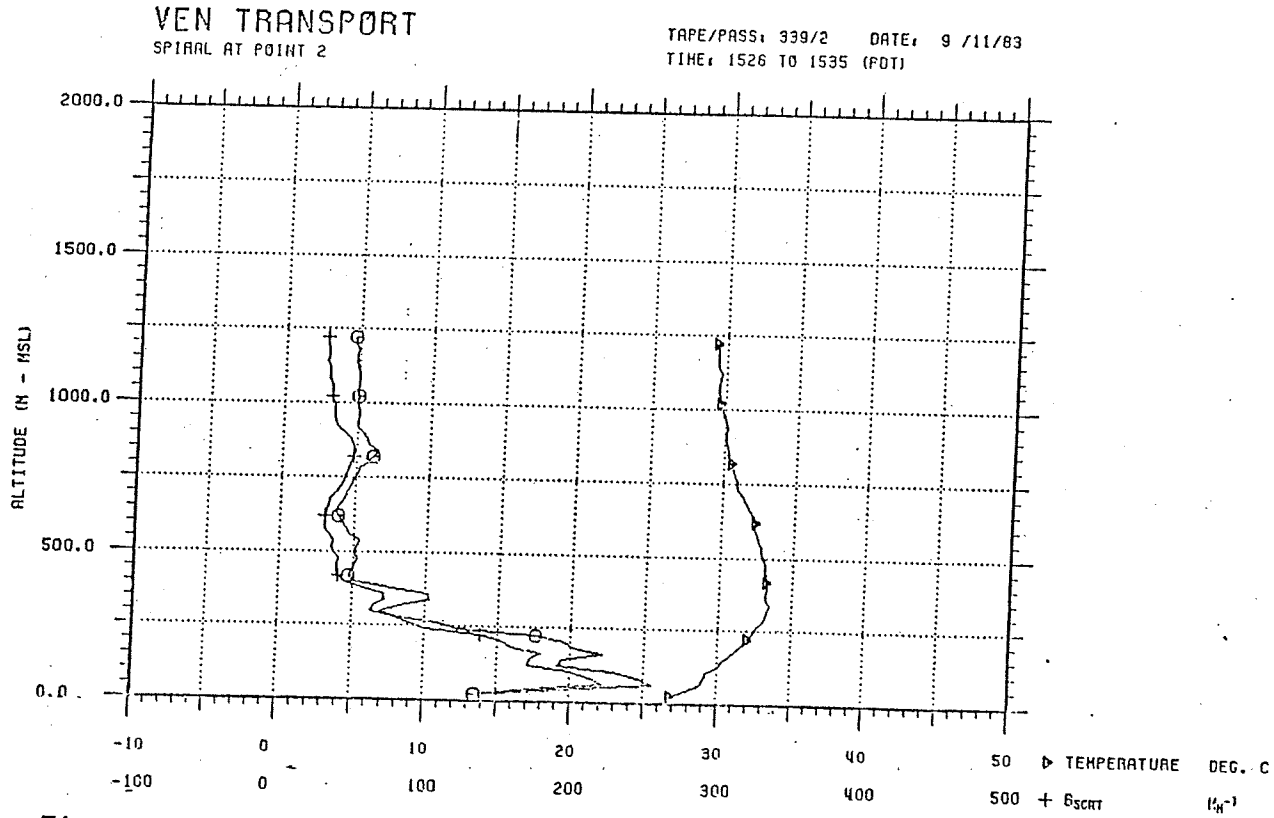

Figure 3-15. Spiral Offshore of Laguna Peak at 1426 PST on September 11, 1983.

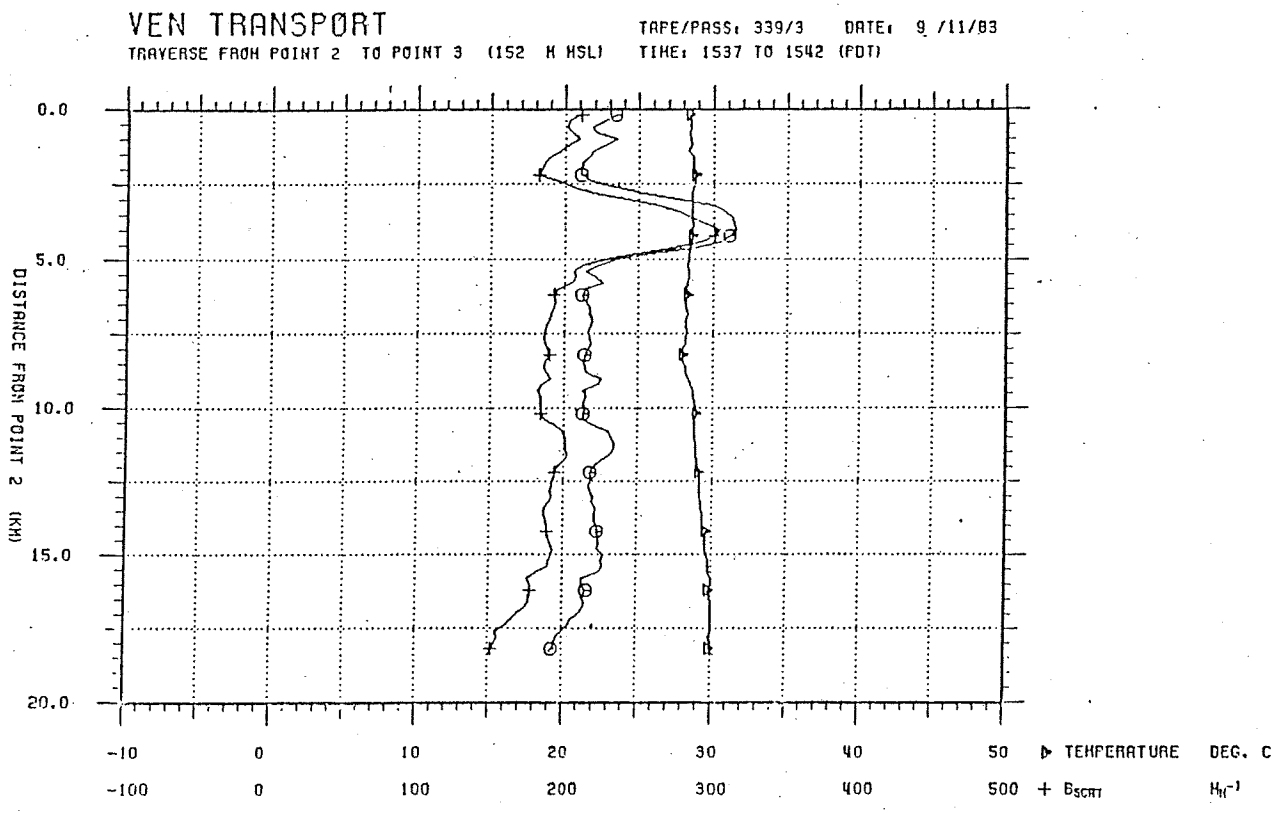

Figure 3-16. Traverse from Shoreline near Laguna Peak to 10 Miles South of Pt. Mugu at 1437 PST on September 11, 1983.

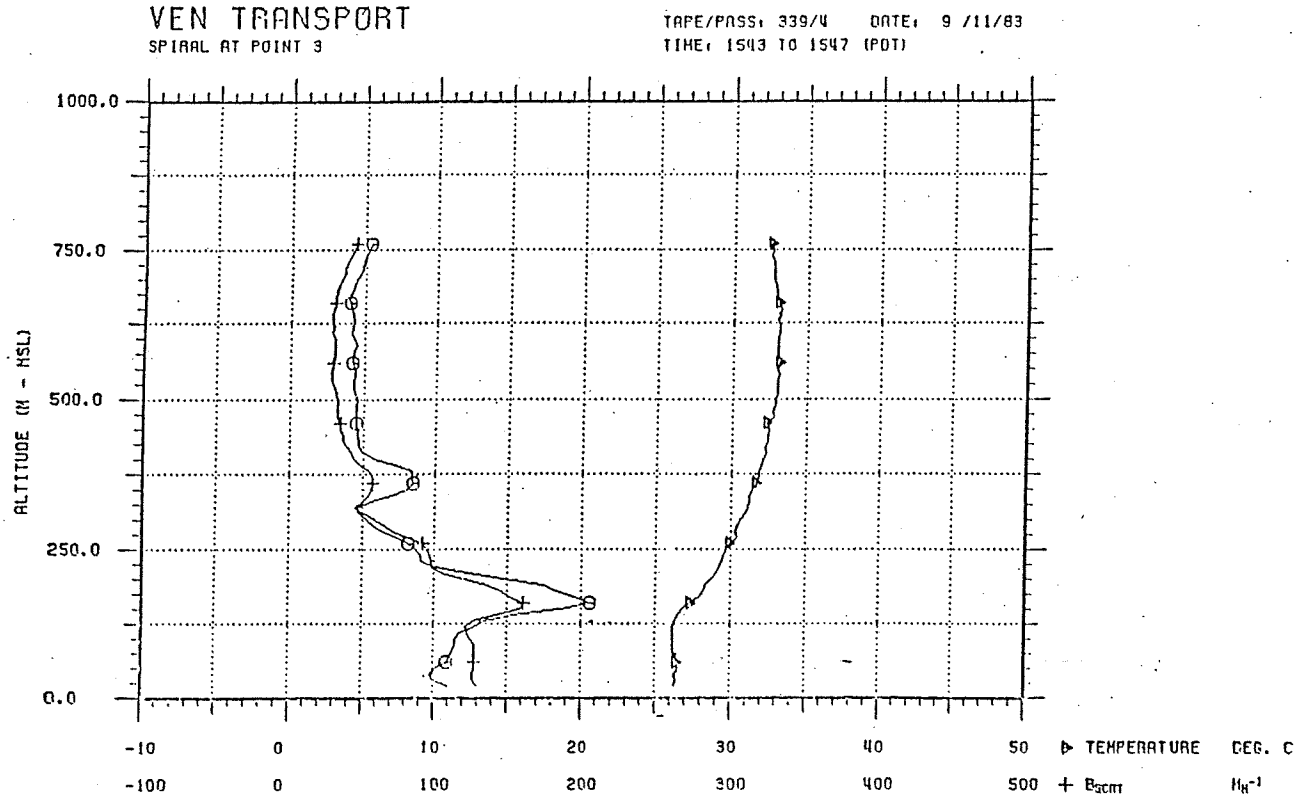

Figure 3-17. Spiral at 10 Miles South of Pt. Mugu at 1443 PST on September 11, 1983.

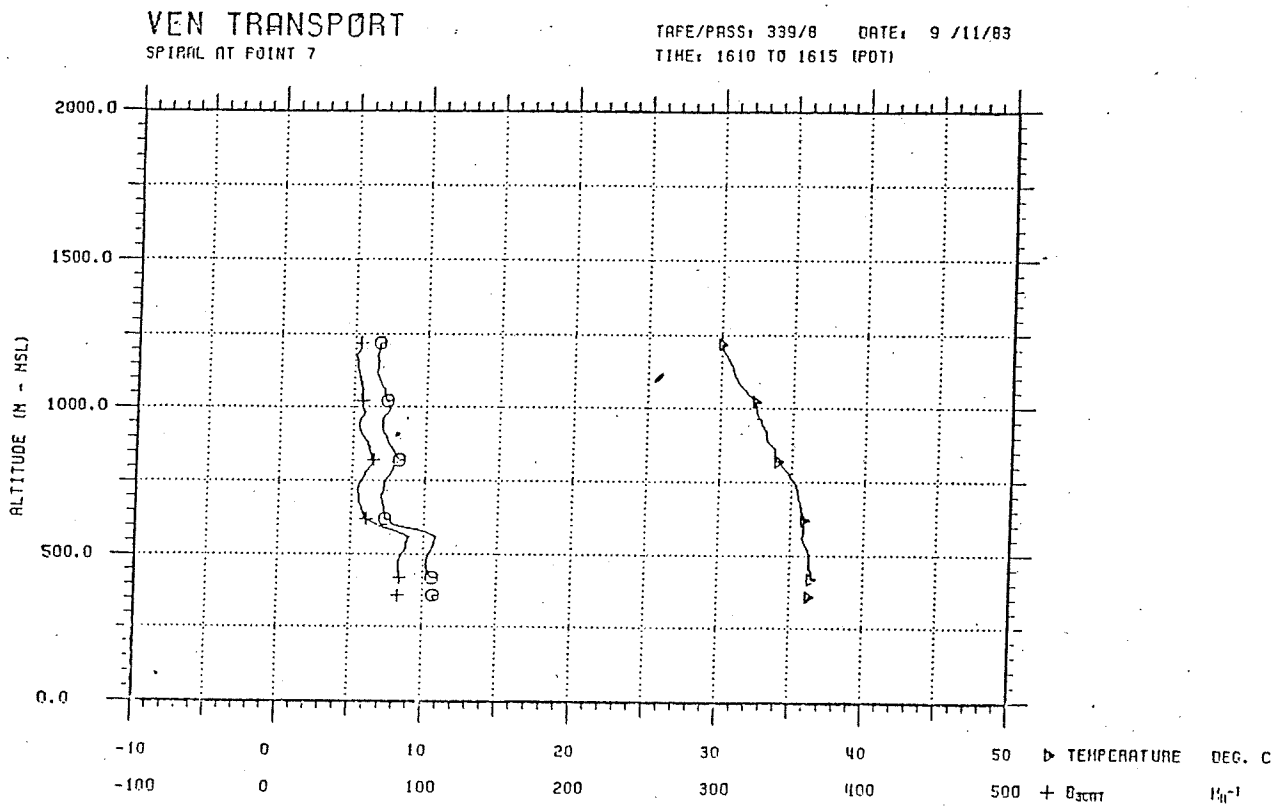

Figure 3-18. Spiral at Westlake Reservoir at 1510 PST on September 11, 1983.

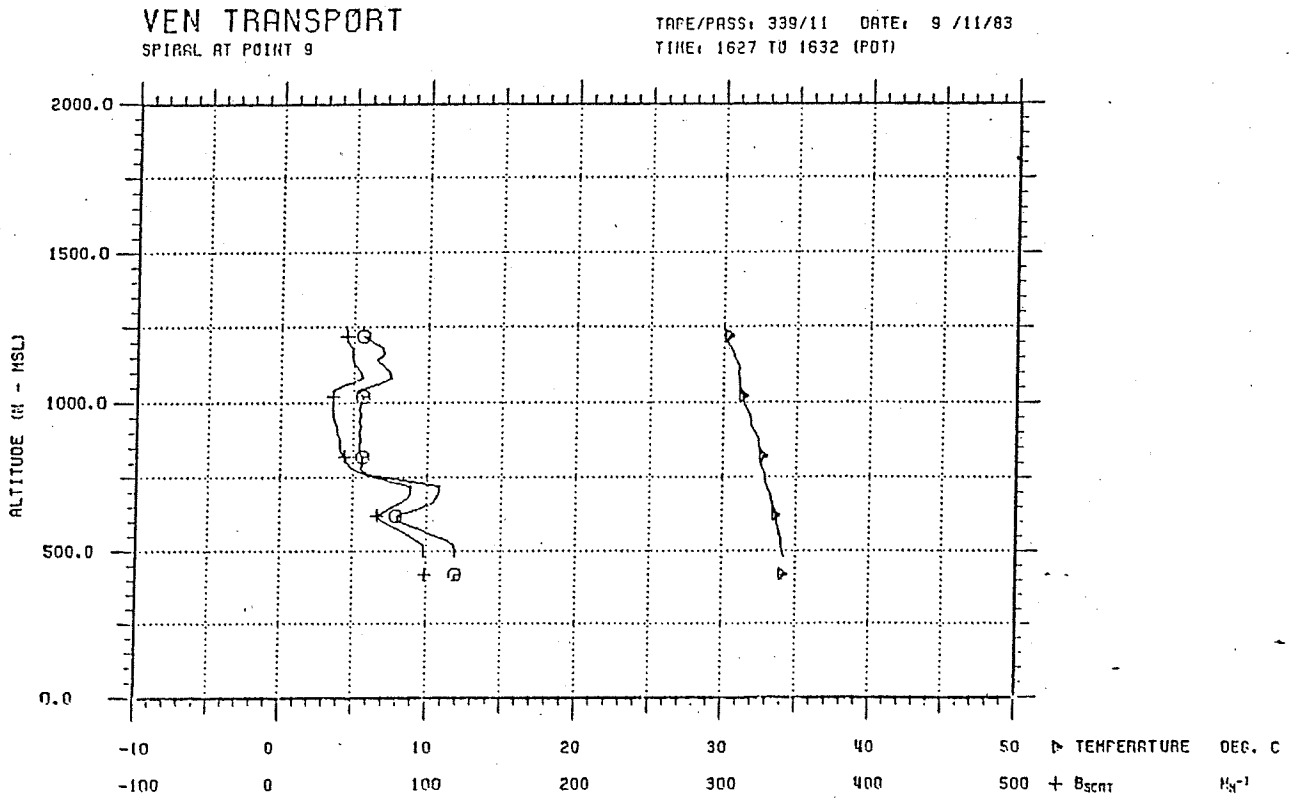

Figure 3-19. Spiral at Simi at 1527 PST on September 11, 1983.

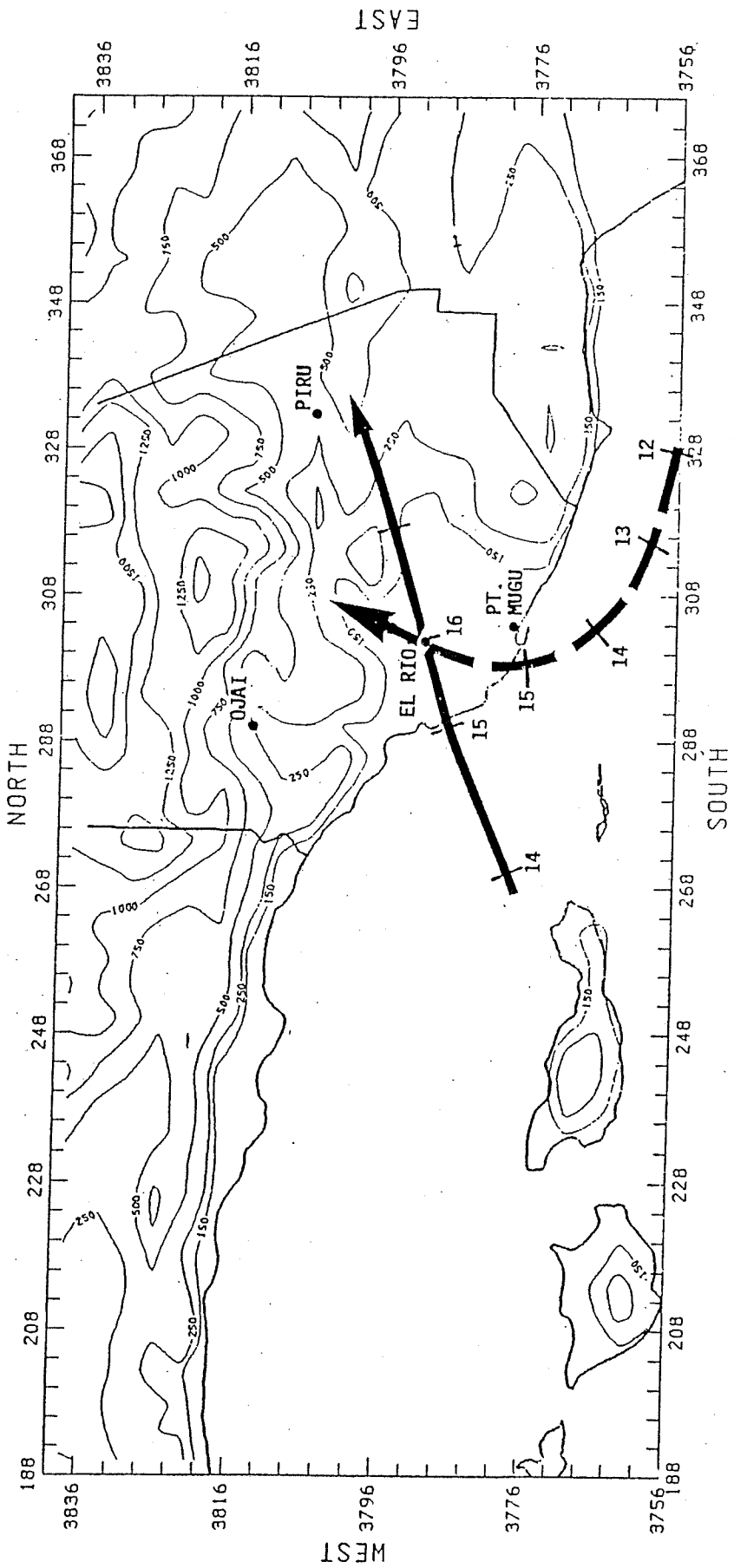

Figure 3-20. Approximate Surface and Elevated Trajectories Arriving at El Rio During the Hour of Maximum Ozone on September 11, 1983. (Solid line is surface level trajectory and dashed line is elevated trajectory. Hours shown are PST.)

Goleta and Santa Barbara experienced peak ozone concentrations of 13 and 12 pphm, respectively, on September 11th but with only one peak. In view of the westerly winds throughout the area, it is not suggested that these concentrations were associated with the ozone layer observed offshore to the south of Ventura. However, they may have been associated with offshore concentrations of pollutants with more local origins.

Surface winds at Santa Barbara and Platform Hondo were easterly to northeasterly throughout the night of September 10th-11th from 2000 to 0800 PST. Thereafter, southwesterly winds prevailed. It is proposed that pollutants existing along the coastal strip on the 10th were carried offshore during the night, were confined to a shallow layer over the water, and were returned to the coast by the sea breeze during the day.

This suggested mechanism represents an internal recycling of pollutants from one day to the next within the South Central Coast Air Basin. It is reasonable to question whether such a mechanism also operates along the Ventura Coast. Observed offshore winds during the night of the 10th along the Ventura Coast, however, do not appear to have been strong enough to carry pollutants very far offshore. Thus, the late ozone peak observed in the Ventura County area has been attributed to transport into the South Central Coast Air Basin from the outside.

3.3.2 September 12, 1983

3.3.2.1 General Meteorology

The high pressure in the northwest continued and merged with a major high pressure area in western Canada (Figure 3-21). The surface thermal low pressure area existed along the California coast, slightly farther to the west than was the case on the 11th. Surface pressure gradients from the inland areas were directed toward the coast from Reno to Las Vegas. High pressure aloft (500 mb) was centered in western Arizona and contributed to subsidence and warm temperatures aloft throughout southern California.

Skies were clear at Santa Barbara throughout the day. Low scattered to broken clouds developed in the Pt. Mugu area about 1400 PST and lasted through 1900 PST. Visibilities at Pt. Mugu decreased to about 1/2 mile by about 1700 PST, increasing during the evening. The low clouds extended as far inland as Oxnard for several hours between 1600 and 1900 PST.

Significant meteorological parameters for September 12, 1983 are summarized in Table 3-10.

The offshore wind flow condition continued on September 12th with an 850 mb temperature one degree warmer than on the 11th. The offshore pressure gradient in central California was somewhat greater than on the 11th and was associated with a more westerly position for the surface low pressure trough along the coast. Inversion bases at Pt. Mugu were quite low and south-southeasterly winds prevailed at 1000 m msl within the temperature inversion.

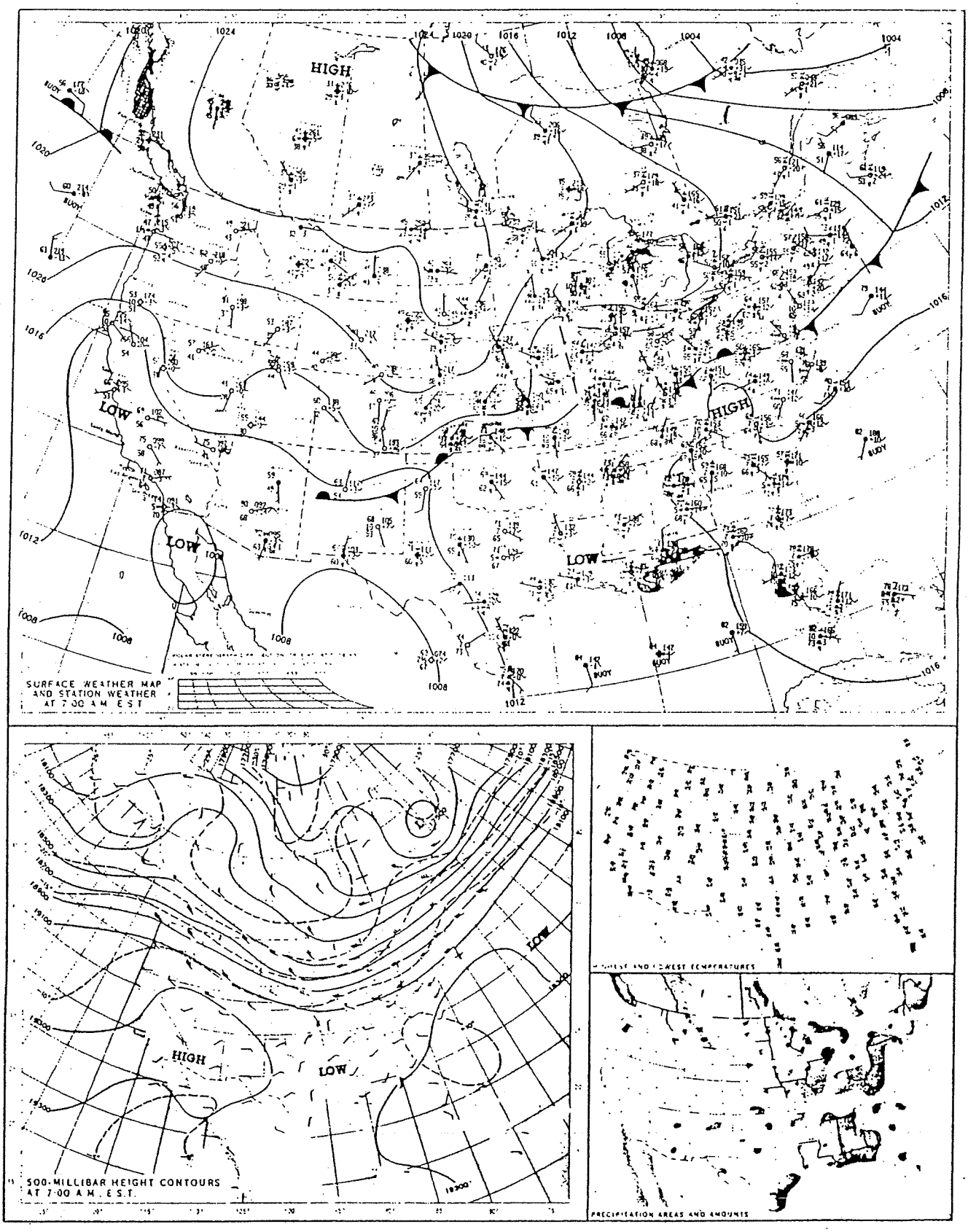

Figure 3-21. Surface and 500 mb Synoptic Weather Maps for 12 September 1983 at 0400 PST.

Table 3-10. Meteorological Parameters for September 12, 1983

	9/12/83	Long Term Average*
850 mb temperature at 0400 PST at Vandenberg AFB	25.5°C	18.1°C
Surface Pressure Gradients (0400 PST)		
San Francisco-Reno	-6.5 mb	-1.2 mb
Los Angeles-Bakersfield	-1.2	-0.1
Los Angeles-Las Vegas	-1.0	1.6
Inversion Base		
Pt. Mugu (0255 PST)	Surface	
Pt. Mugu (0847 PST)	Surface	
Pt. Mugu (1505 PST)	180 m msl	
Upper Winds (1000 m msl)		
Pt. Mugu (0255 PST)	304°/2.5 m/s	
Pt. Mugu (0847 PST)	132°/2	
Pt. Mugu (1505 PST)	180°/1	

*average September values (1980-83).

3.3.2.2 Transport Winds

Table 3-11 gives the surface wind observations for several locations on September 12th.

Table 3-11. Surface Transport Wind Summary for September 12, 1983

Time (PST)	eLaguna Peak (deg./m/s)	Platform Grace (deg./m/s)	Pt. Mugu (deg./m/s)	Santa Barbara (deg./m/s)
0600	120/5	109/3.1	060/1	060/3
0800	110/3	129/3.6	030/1	050/2
1000	150/6	143/5.3	150/6	140/5
1200	140/3	138/4.8	150/6	150/5
1400	120/9	160/3.0	190/5	150/6
1600	140/8	138/3.7	190/4	200/5
1800	130/7	133/2.5	170/3	120/2
2000	090/4	155/1.0	calm	calm
2200	050/2	100/3.0	150/1	090/2

Wind directions observed at Simi by the doppler acoustic sounder on September 12th are given in Table 3-12.

Table 3-12. Doppler Acoustic Sounder Wind Directions at Simi at 1000 m msl for September 12, 1983

Time (PST)	Wind (deg.)	Time (PST)	Wind (deg.)
0800	056	1600	M
1000	135	1800	M
1200	105	2000	M
1400	M	2200	M

Wind flow patterns on September 12th indicate a southeasterly flow throughout the area during the entire day. There was little sign of the customary sea breeze except for a slight influence for a few hours in mid-afternoon at Pt. Mugu and Santa Barbara. From the available acoustic sounder data, the upper wind flow at Simi was also from the southeast at all levels to 1000 m msl through 1200 PST when a system malfunction occurred.

The wind patterns on September 12th were very conducive to the transport of pollutants from the South Coast Air Basin into the South Central Coast Basin.

3.3.2.3 Mixing Heights

Mixing heights as determined from aircraft soundings on September 12, 1983 are shown in Table 3-13.

Table 3-13. Mixing Heights from Aircraft Soundings on September 12, 1983

	Time (PST)	Mixing Depth (m agl)
Camarillo (sfc. elev. 25 m)		
	0522	75
	0914	225
	1427	150
Pt. 2 (3 mi SSW Laguna Peak)		
	0534	150
	0927	150
	1442	(350) top of stratus
Pt. 3 (13 mi SSW Laguna Peak)		
	0944	100
	1457	stratus
Westlake Reservoir (sfc. elev. 305 m)		
	0618	200
	1012	400
	1523	400
Simi (sfc. elev. 335 m)		
	0639	310
	1031	360
	1541	360

Mixing heights continued low on September 12th but increased slightly from the values observed on September 11th. Inland mixing heights remained relatively low compared to average afternoon conditions.

3.3.2.4 Regional Ozone Concentrations

Maximum ozone concentrations for September 12th in the South Central Coast Air Basin are presented in Table 3-14 together with the time of the maximum concentration and the observed wind at the time of the maximum.

Table 3-14. Maximum Ozone Concentrations on September 12, 1983

Location	Maximum Concentration (pphm)	Time of Maximum (PST)	Wind (deg./m/s)
Ojai	14	15	220/3
Piru	17	12-13	245/M
Simi	23	13	139/4
Thousand Oaks	18	12	
Rocketdyne	24	13	148/4
El Rio	-	-	
Laguna Peak	13	11-12	145/4
Ventura	15	12	200/5
La Conchita	10	12	
Santa Barbara	11	12	150/5
Goleta	13	13	
El Capitan Beach	13	14-16	

Ozone exceedances occurred at most reporting stations in the South Central Coast Air Basin on September 12th. Highest values occurred near the Simi Hills but the coastal areas as far west as El Capitan Beach also recorded high ozone values.

3.3.2.5 Transport Analysis

Figure 3-22 shows the hourly ozone concentrations for September 12th for several locations in Ventura County. The earliest ozone peak occurred at Laguna Peak and the latest at Ojai. A comparison of the times of maximum ozone suggests transport from the southeast with the Ventura and Piru maximum times falling between Laguna Peak and Ojai. Table 3-14, however, gave a time of maximum ozone occurrence of 1200 PST at both Santa Barbara and Ventura. The flow patterns and the timing of the ozone maxima suggest that the ozone peaks at Santa Barbara and Ventura on September 12th resulted from different scenarios. The Santa Barbara peak (Table 3-14) was seen to move westward past Goleta and El Capitan Beach in the few hours after 1200 PST while the Ventura peak traveled inland toward Ojai. The transport evidence derived from the peak ozone times, therefore, suggests southeasterly transport in both the Ventura and Santa Barbara areas, but the two areas did not appear to be under the influence of ozone from the same source region.

Figures 3-23 and 3-24 present the early morning aircraft soundings at Camarillo and 3 mi SSW of Laguna Peak (Point 2). Although the Camarillo ozone

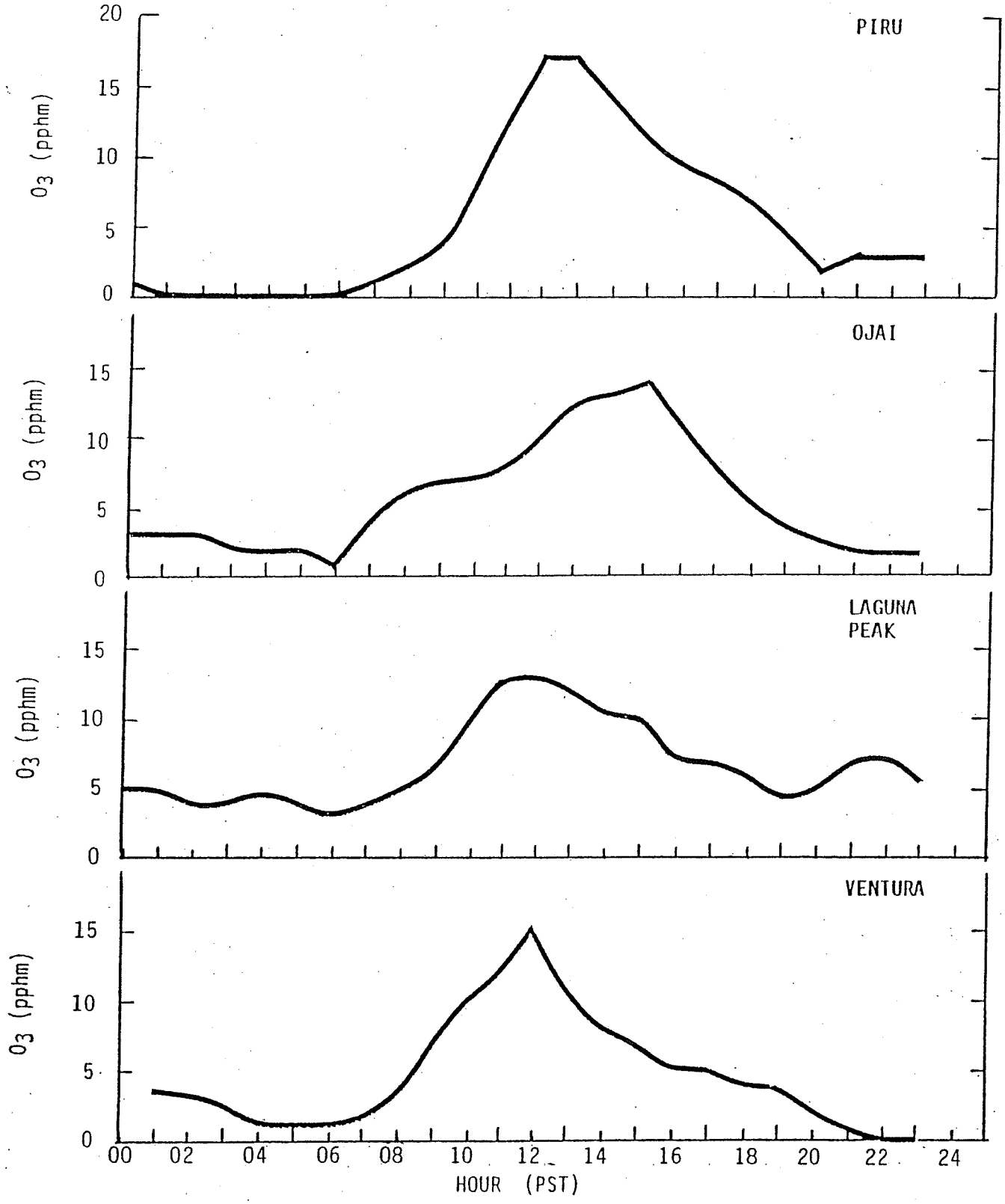

Figure 3-22. Hourly Average Ozone Concentrations for 12 September 1983.

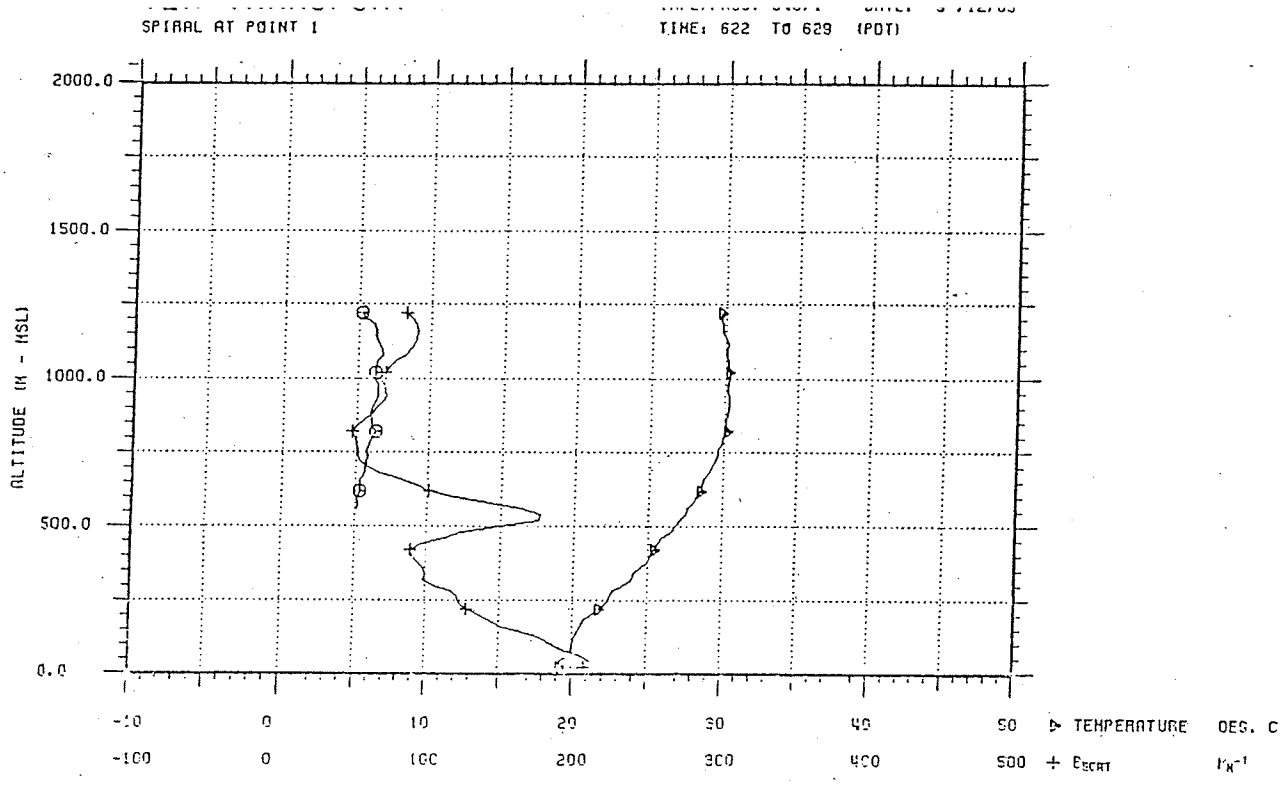

Figure 3-23. Spiral at Camarillo Airport at 0522 PST on September 12, 1983.

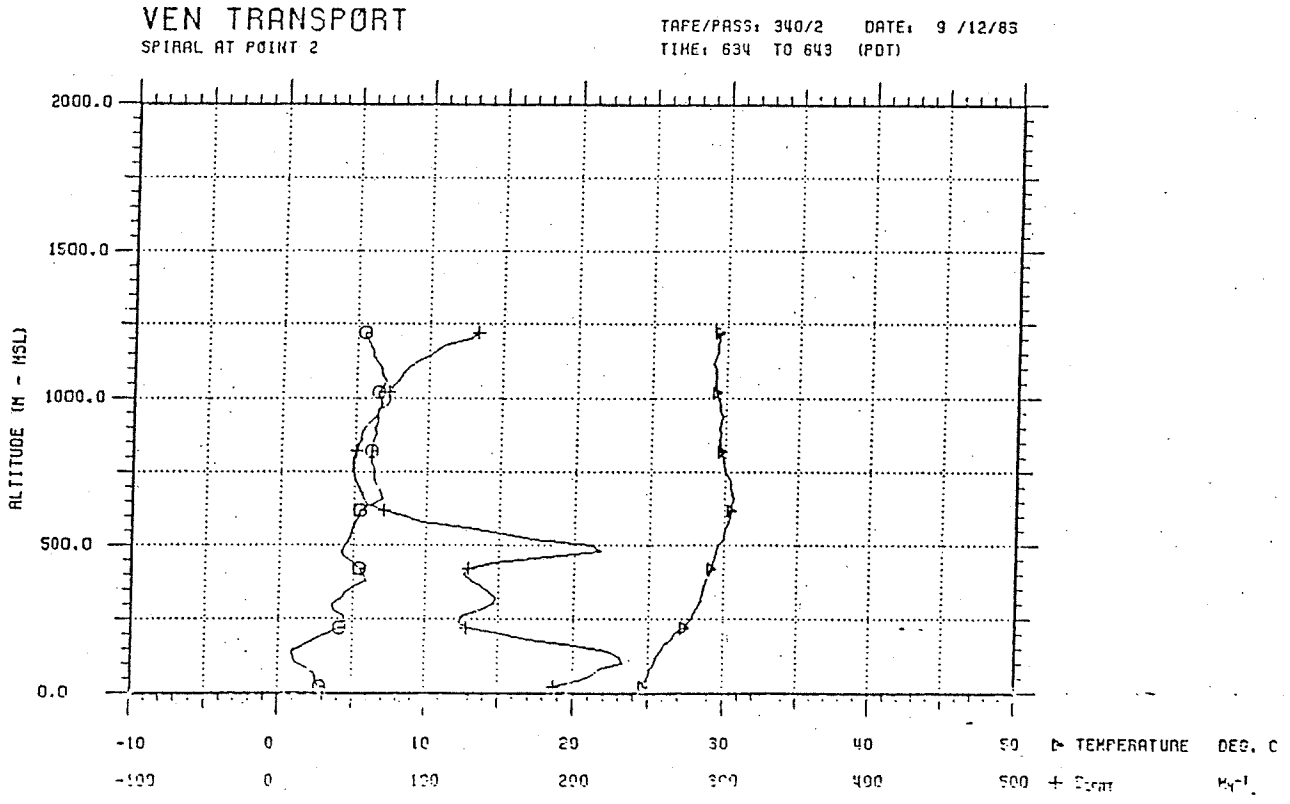

Figure 3-24. Spiral Offshore of Laguna Peak at 0534 PST on September 12, 1983.

sounding was incomplete, there was no evidence for ozone concentrations above the normal background levels. These observations were confirmed by the remaining morning soundings at Simi, Westlake Reservoir, and offshore.

By the late morning flight, however, increased ozone concentrations were observed at all locations. Figure 3-25 shows the mid-morning sounding at Camarillo with an elevated layer (peak 14 pphm) between 250 and 650 m msl. As indicated, this layer exists within the temperature inversion. Increased concentrations are indicated at Point 2 (3 mi SSW Laguna Peak) from the surface to 650 m msl in Figure 3-26 and from 200 to 500 m msl at Pt. 3 (13 mi. SSW of Laguna Peak) in Figure 3-27. In both cases, the ozone layers existed within the temperature inversion. Figure 3-28 shows a horizontal traverse between Pts. 2 and 3 at 366 m msl. The data show the sharp edge of the ozone cloud at that level about half-way between the two points.

Inland at Westlake Reservoir and Simi, high ozone concentrations were observed below 700 and 600 m msl, respectively, decreasing to background levels aloft. A more striking profile is shown in Figure 3-29 which was taken slightly offshore of Ventura. A strong layer of ozone existed within the temperature inversion between 250 and 650 m msl with a peak value of about 22 pphm. There is also an indication in the sounding of an additional ozone layer near 750 m msl.

The appearance of this ozone layer aloft between 0900 and 1130 PST, as evidenced by the soundings, coincides with the arrival of surface ozone concentrations at elevated stations in the area. Peak ozone at Laguna Peak occurred at 1100-1200 PST with a southeast wind flow.

Surface conditions at Rocketdyne and Simi are shown in Figure 3-30. In both cases, the peak ozone occurred in a southeasterly flow regime and suggests direct transport into the area from the southeast. For both Piru and Ojai, however, the peak ozone occurred under a southwesterly flow regime. This suggests that the layer aloft mixed downward in these areas after the seabreeze flow had started (0900 PST at both locations).

Figures 3-31 and 3-32 give the aircraft soundings at Camarillo and 3 mi offshore in the mid-afternoon. A distinct mixing layer existed at Camarillo with two ozone layers above the base of the inversion centered at 450 and 750 m msl. Stratus clouds over the water prevented the lower layer ozone peak from being observed at the offshore location but the higher layer (800 m msl) was apparent. The traverse shown Figure 3-33 indicates that the ozone layer at 396 m msl did not extend as far west as found in the mid-morning flight (Figure 3-28). No significant ozone above background was found above the stratus clouds at Point 3 (Figure 3-34).

Figures 3-35 and 3-36 show the aircraft soundings at Westlake Reservoir and Simi for the late afternoon flight. Both soundings show that the elevated layer (700 to 1250 m msl) did not mix downward to the surface at these locations. High ozone levels near the surface of 18-19 pphm, however, were probably strongly influenced by the lower ozone layer.

The flow patterns on September 12th are summarized in Figure 3-37. Upper level trajectories indicate that an extensive ozone layer moved from the southeast into the South Central Coast Air Basin. Surface winds and trajectories in portions of Ventura County indicate that some of the lower

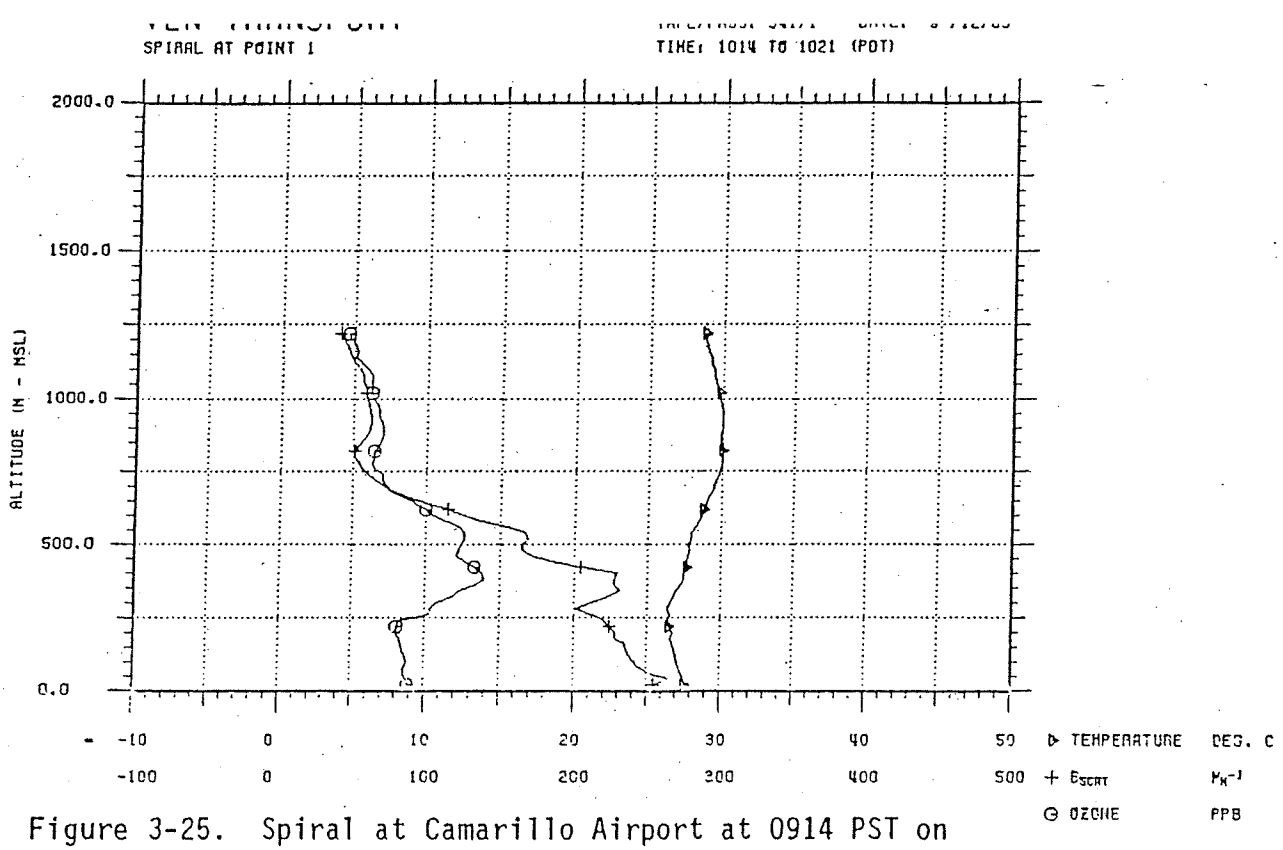

Figure 3-25. Spiral at Camarillo Airport at 0914 PST on September 12, 1983.

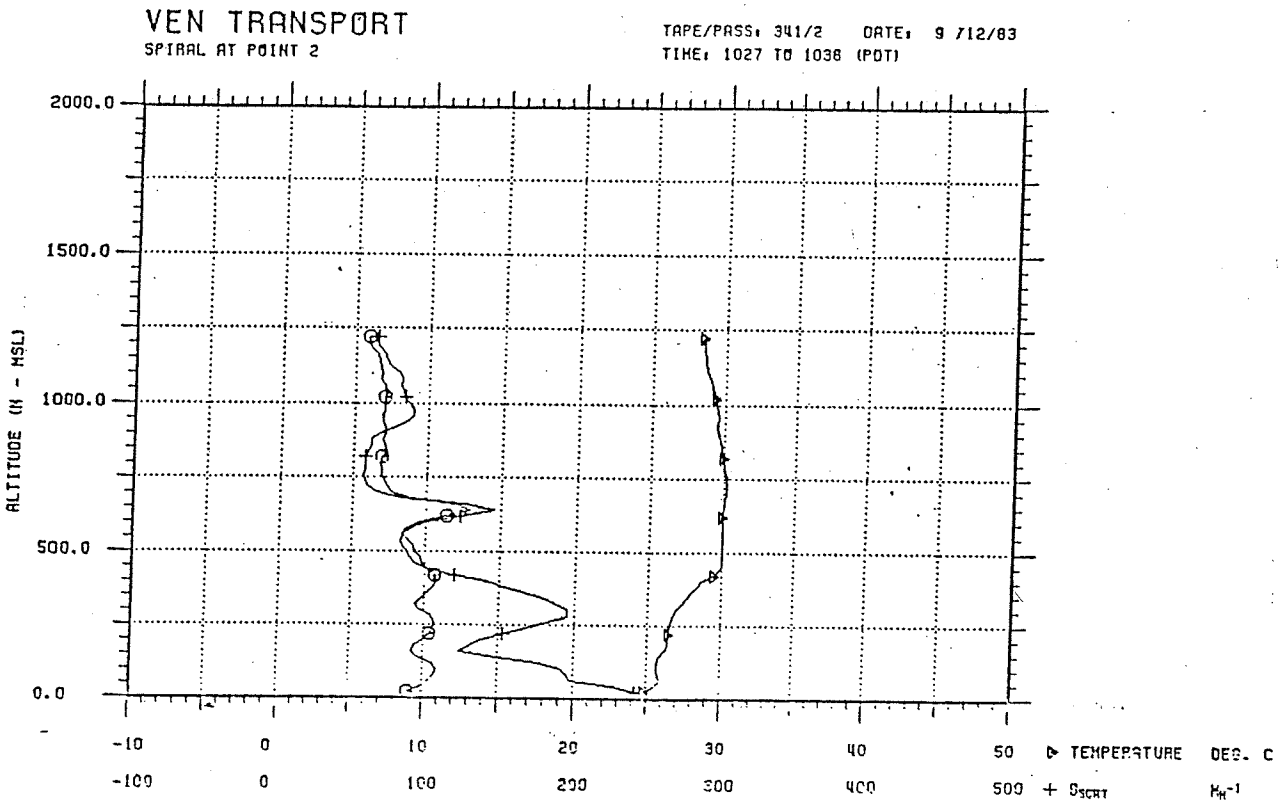

Figure 3-26. Spiral Offshore of Laguna Peak at 0927 PST on September 12, 1983.

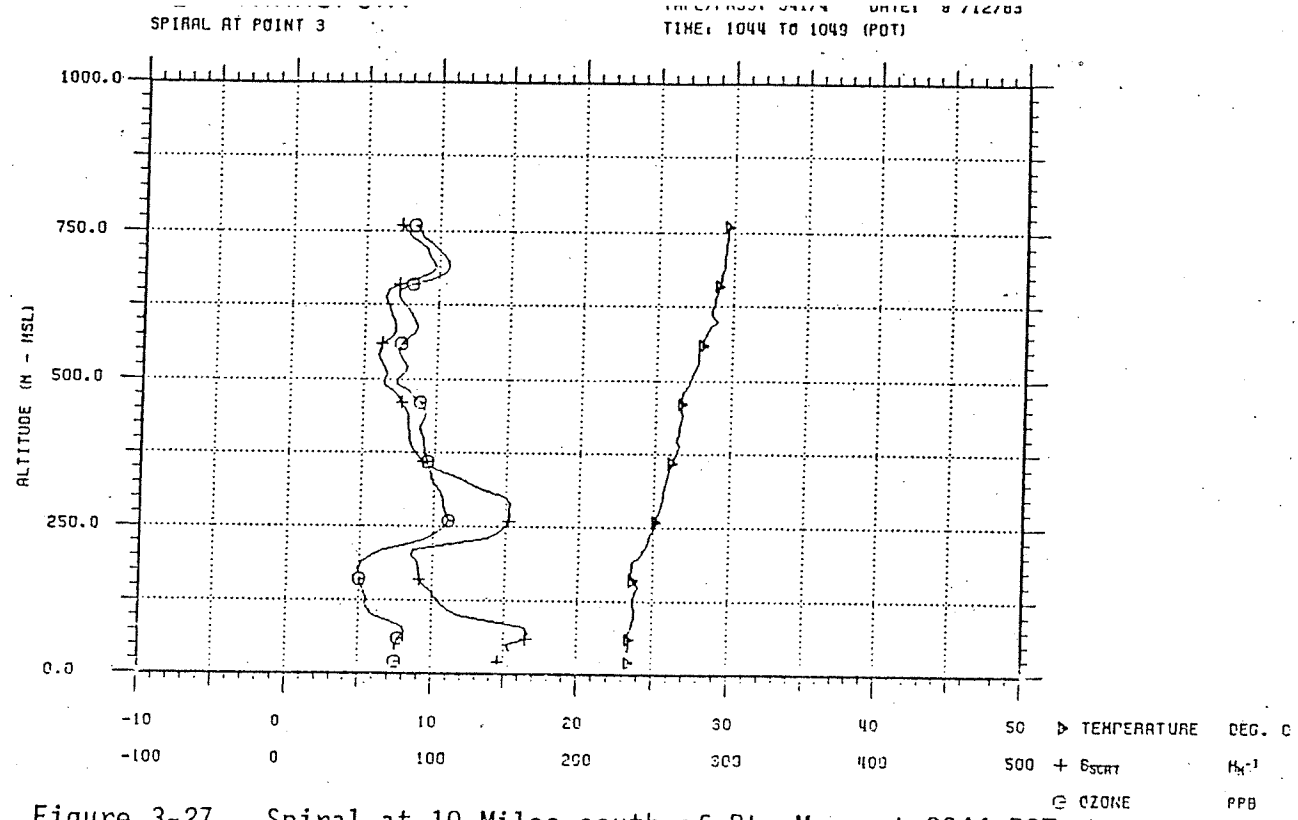

Figure 3-27. Spiral at 10 Miles south of Pt. Mugu at 0944 PST on September 12, 1983.

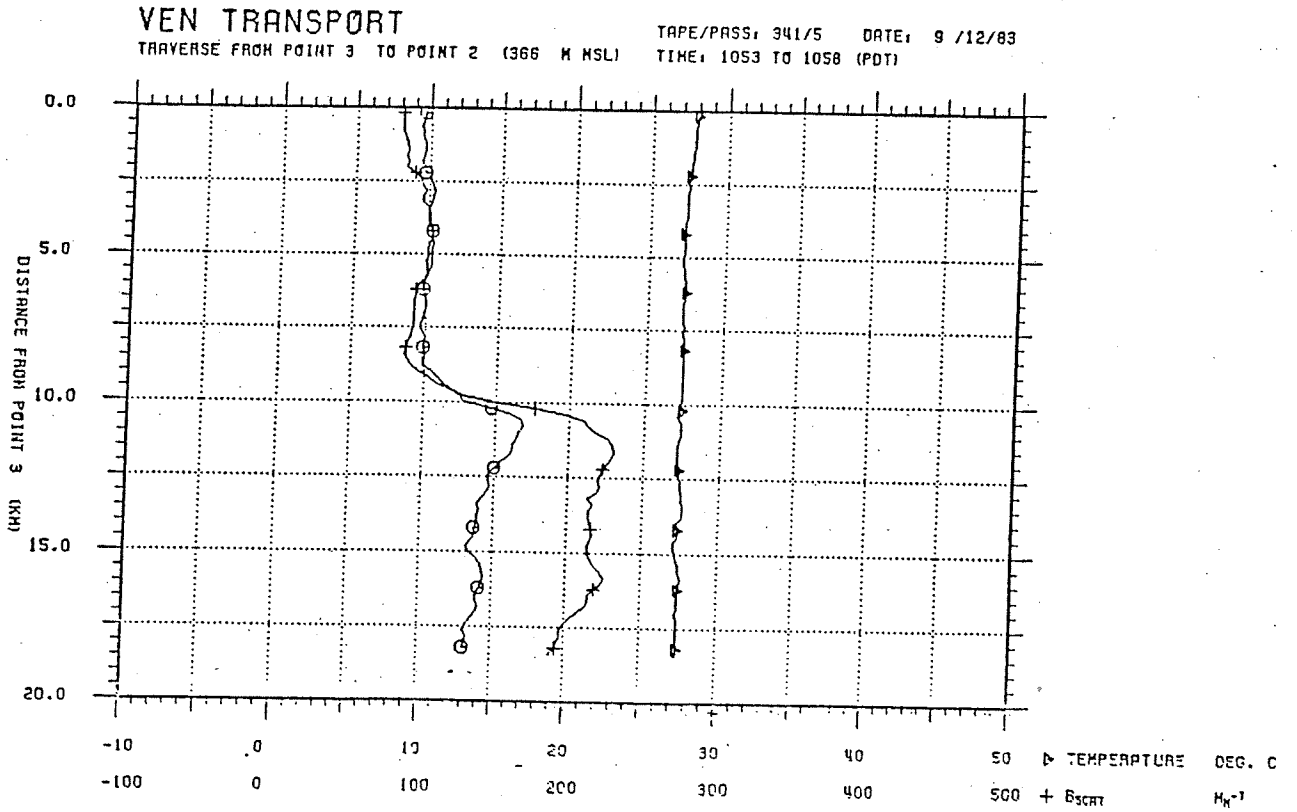

Figure 3-28. Traverse from 10 Miles South of Pt. Mugu to Shoreline near Laguna Peak at 0953 PST on September 12, 1983.

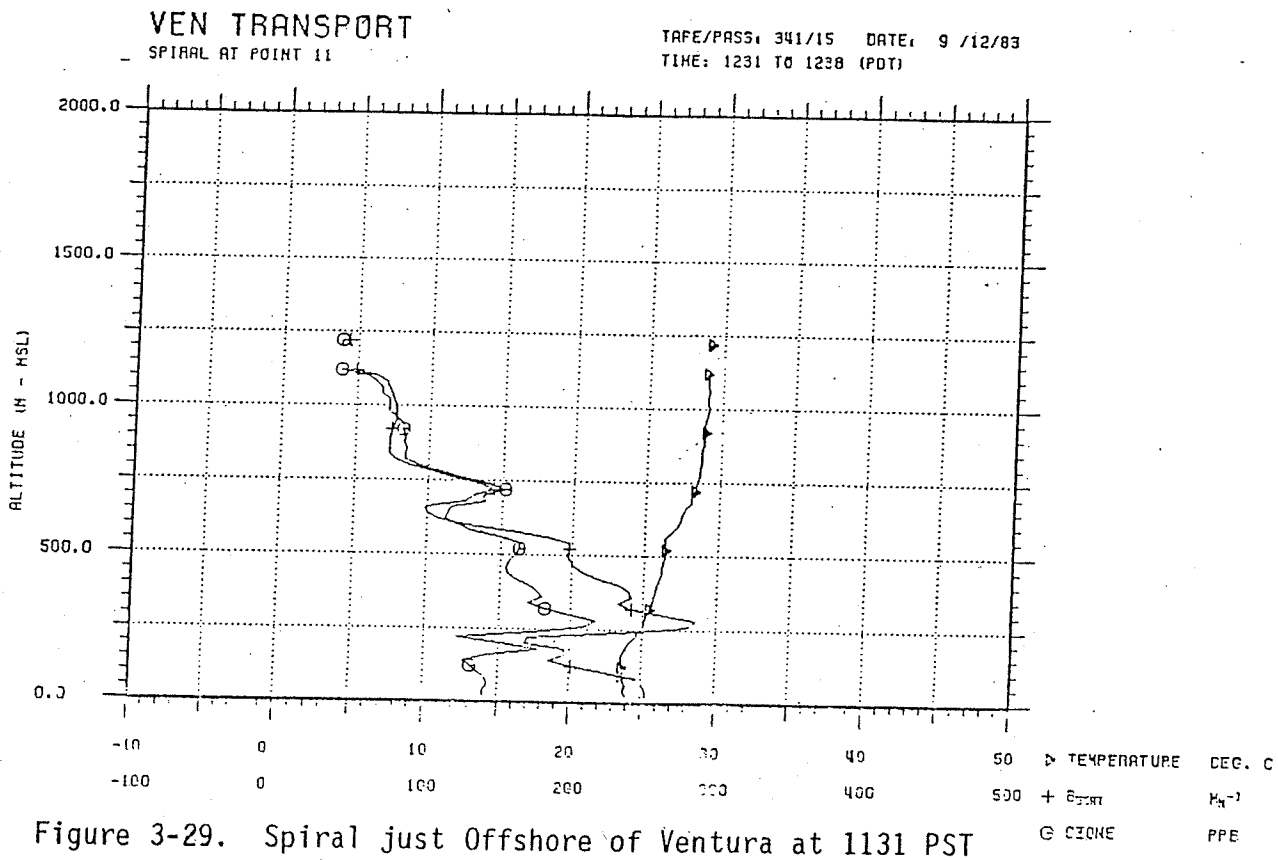

Figure 3-29. Spiral just Offshore of Ventura at 1131 PST on September 12, 1983.

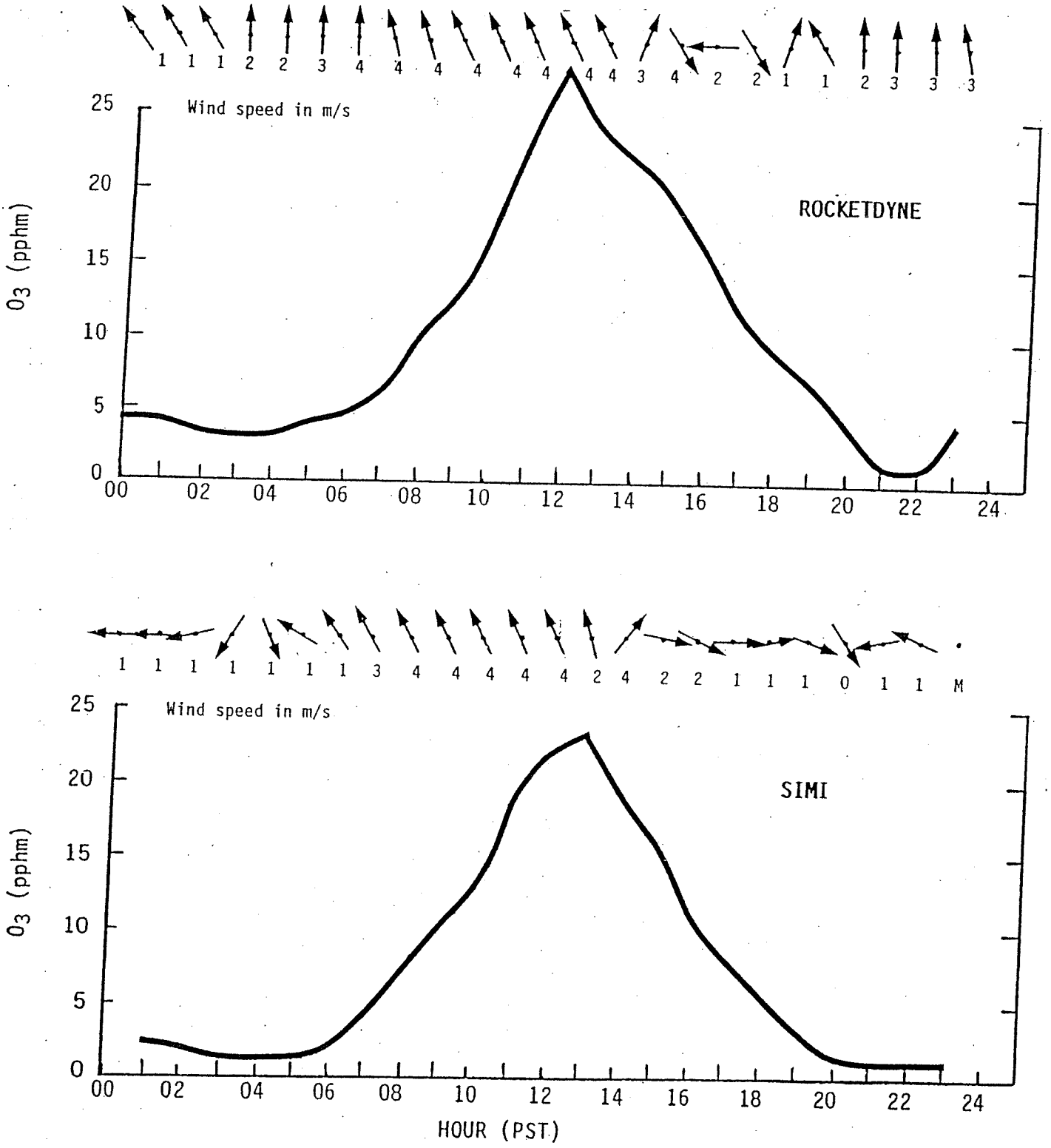

Figure 3-30. Hourly Ozone, Wind Speed and Wind Direction at Rocketdyne and Simi on september 12, 1983.

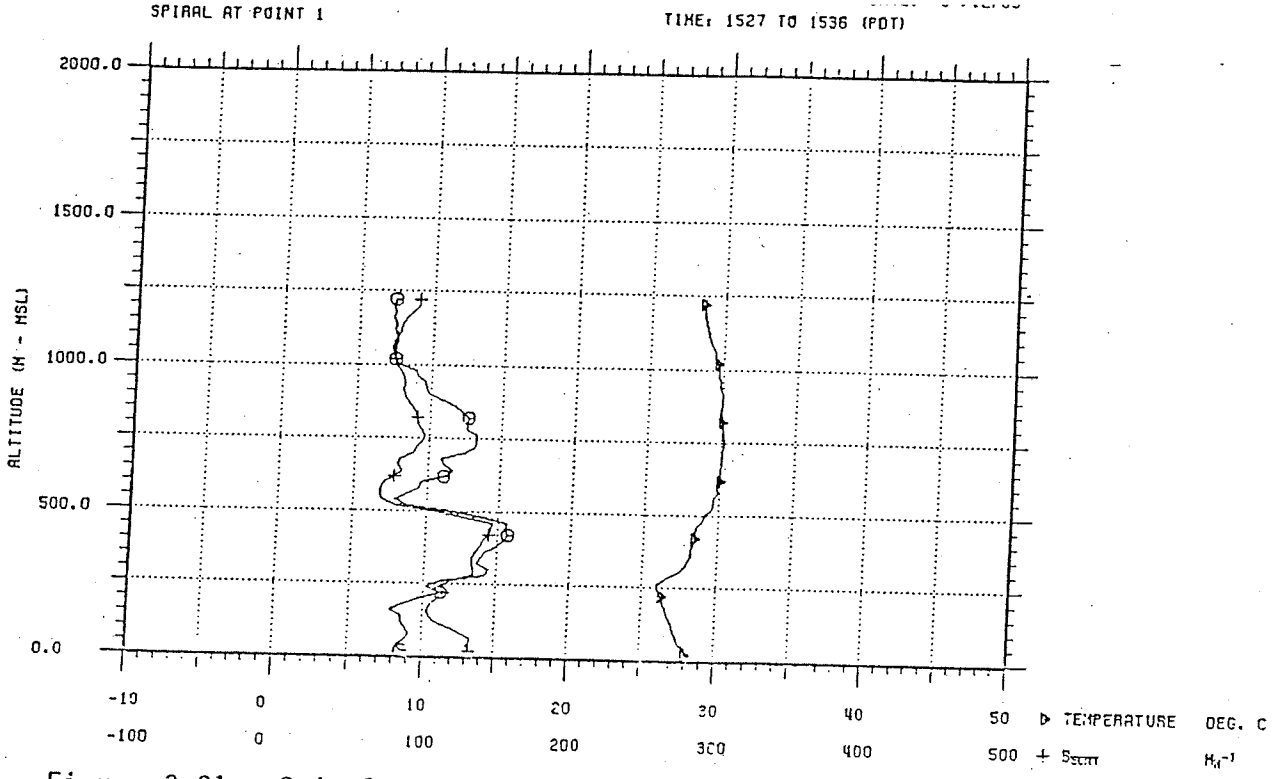

Figure 3-31. Spiral at Camarillo Airport at 1427 PST on September 12, 1983.

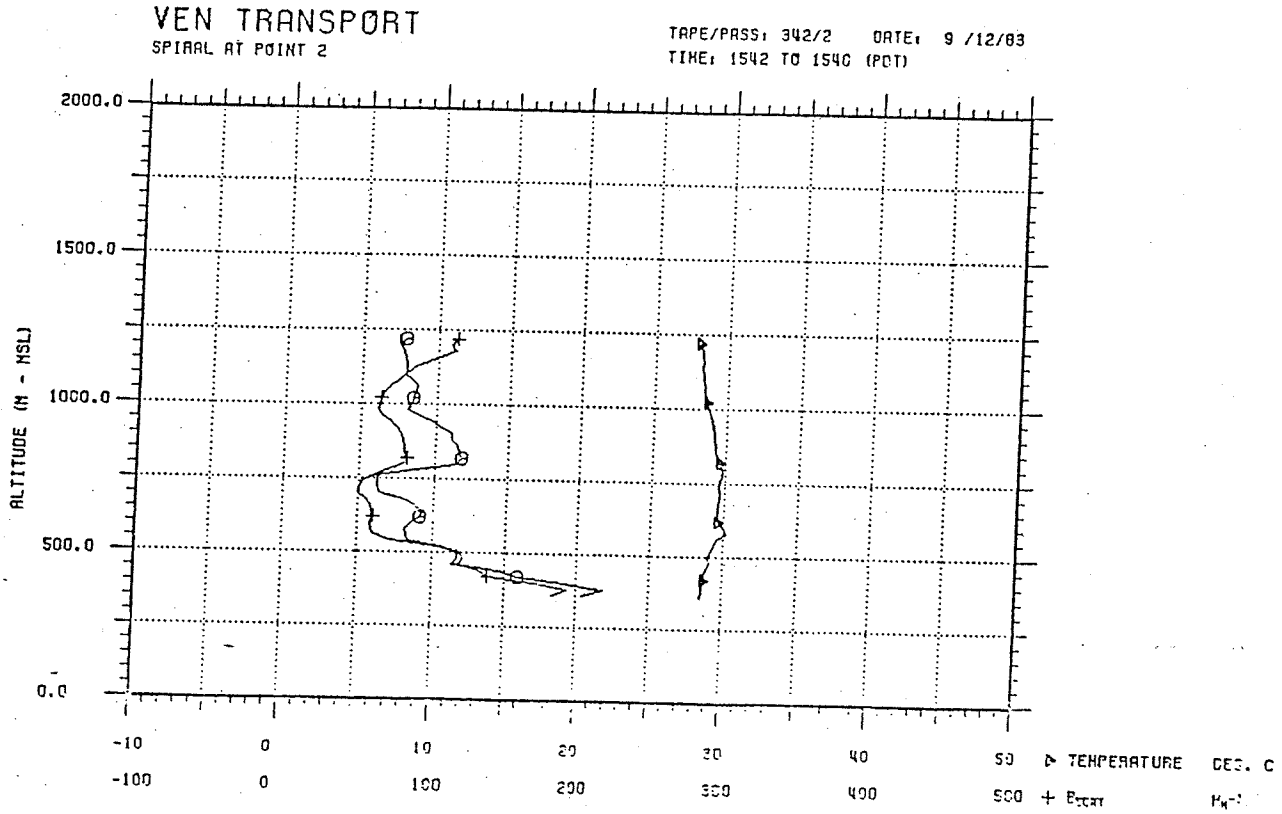

Figure 3-32. Spiral Offshore of Laguna Peak at 1442 PST on September 12, 1983.

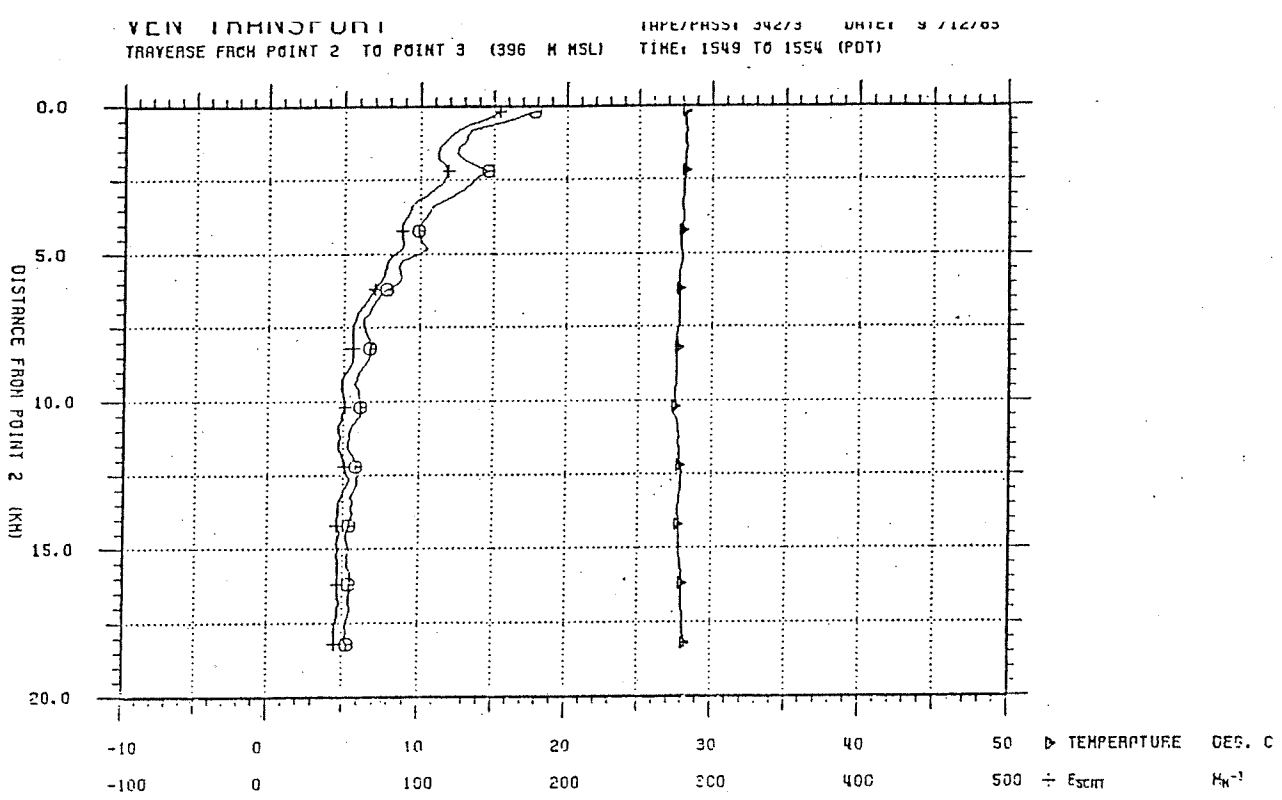

Figure 3-33. Traverse from Shoreline near Laguna Peak to 10 Miles South of Pt. Mugu at 1449 PST on September 12, 1983.

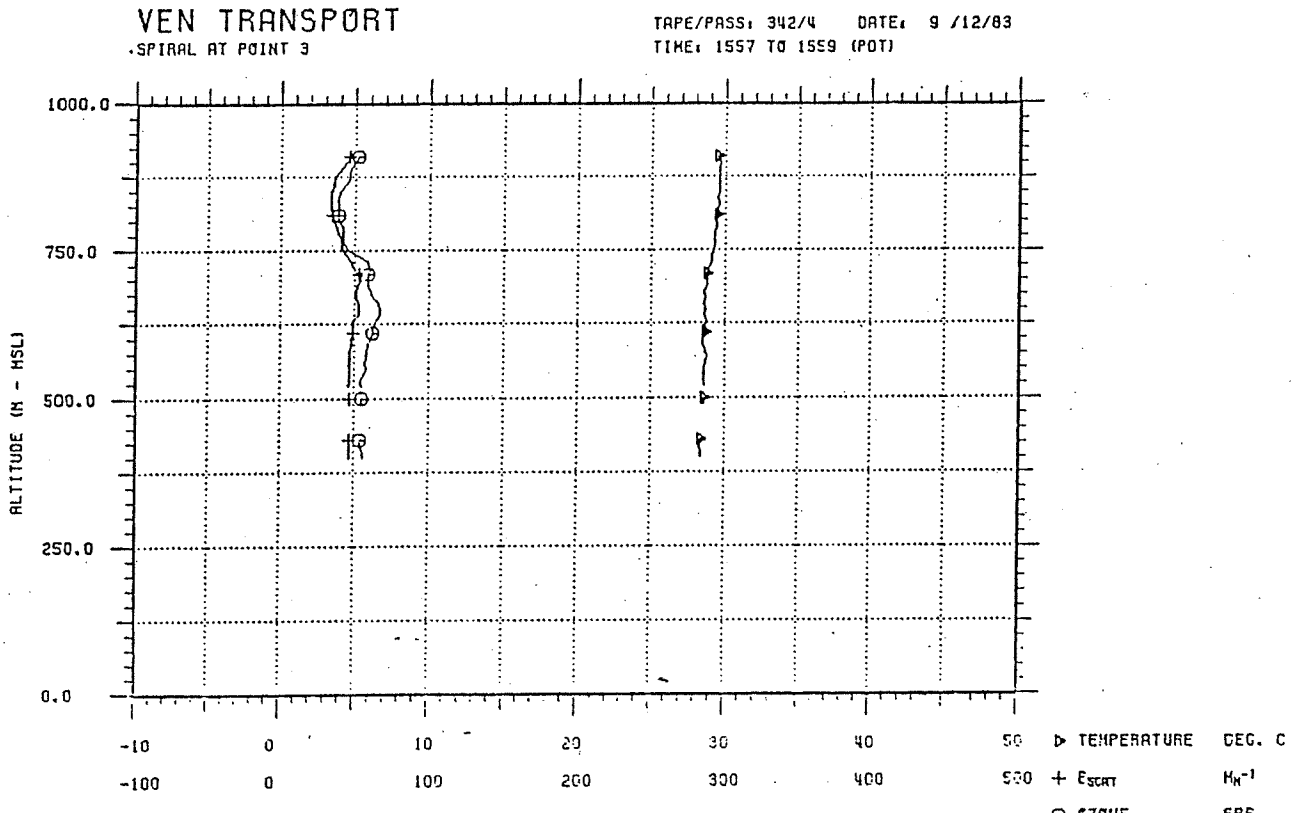

Figure 3-34. Spiral at 10 Miles South of Pt. Mugu at 1447 PST on September 12, 1983.

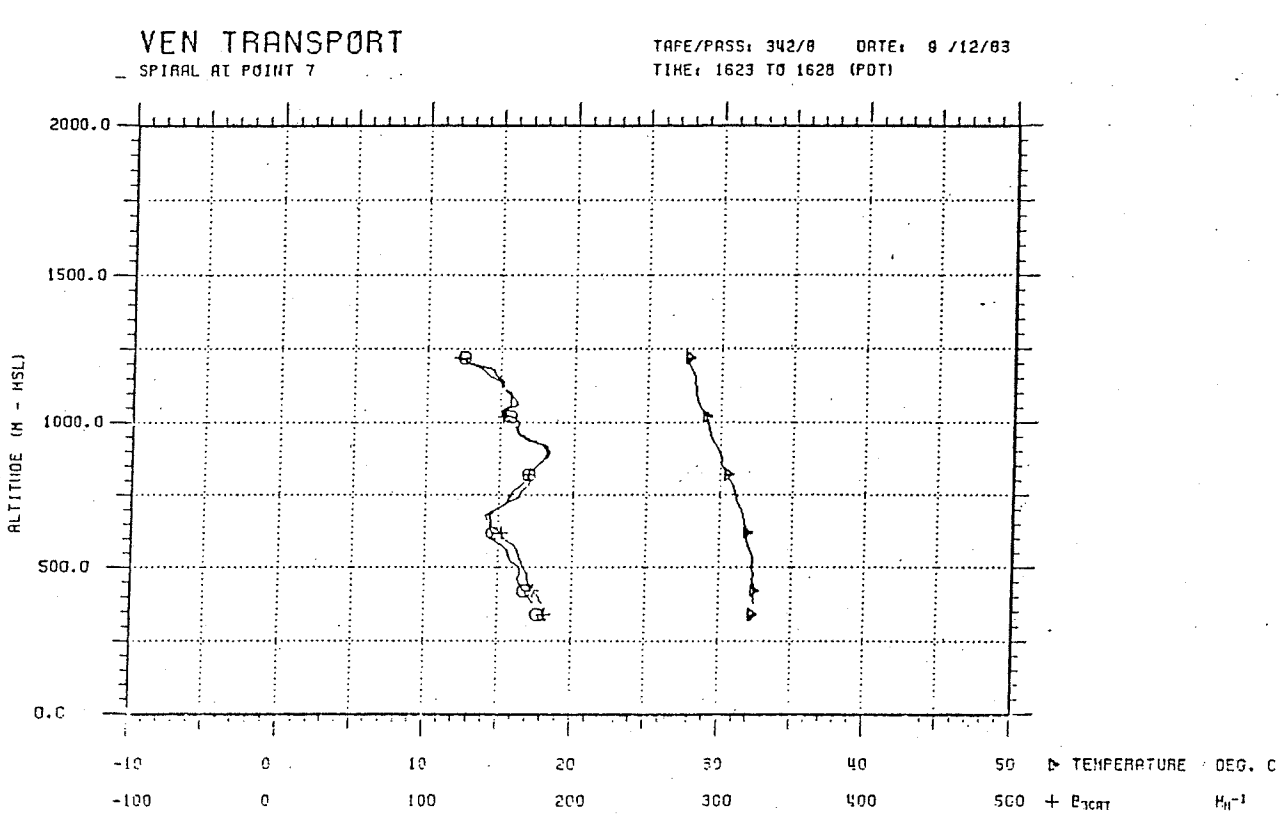

Figure 3-35. Spiral at Westlake Reservoir at 1523 PST on September 12, 1983.

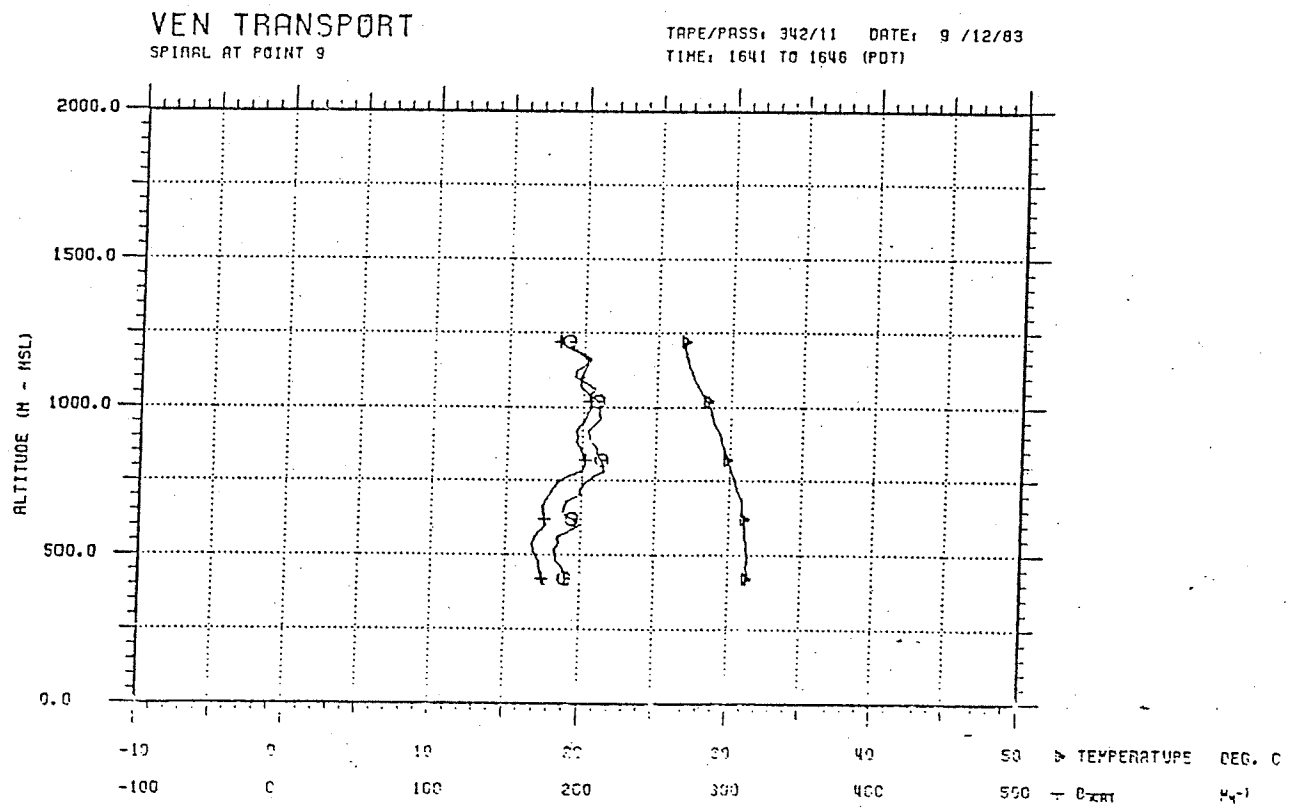

Figure 3-36. Spiral at Simi at 1541 PST on September 12, 1983.

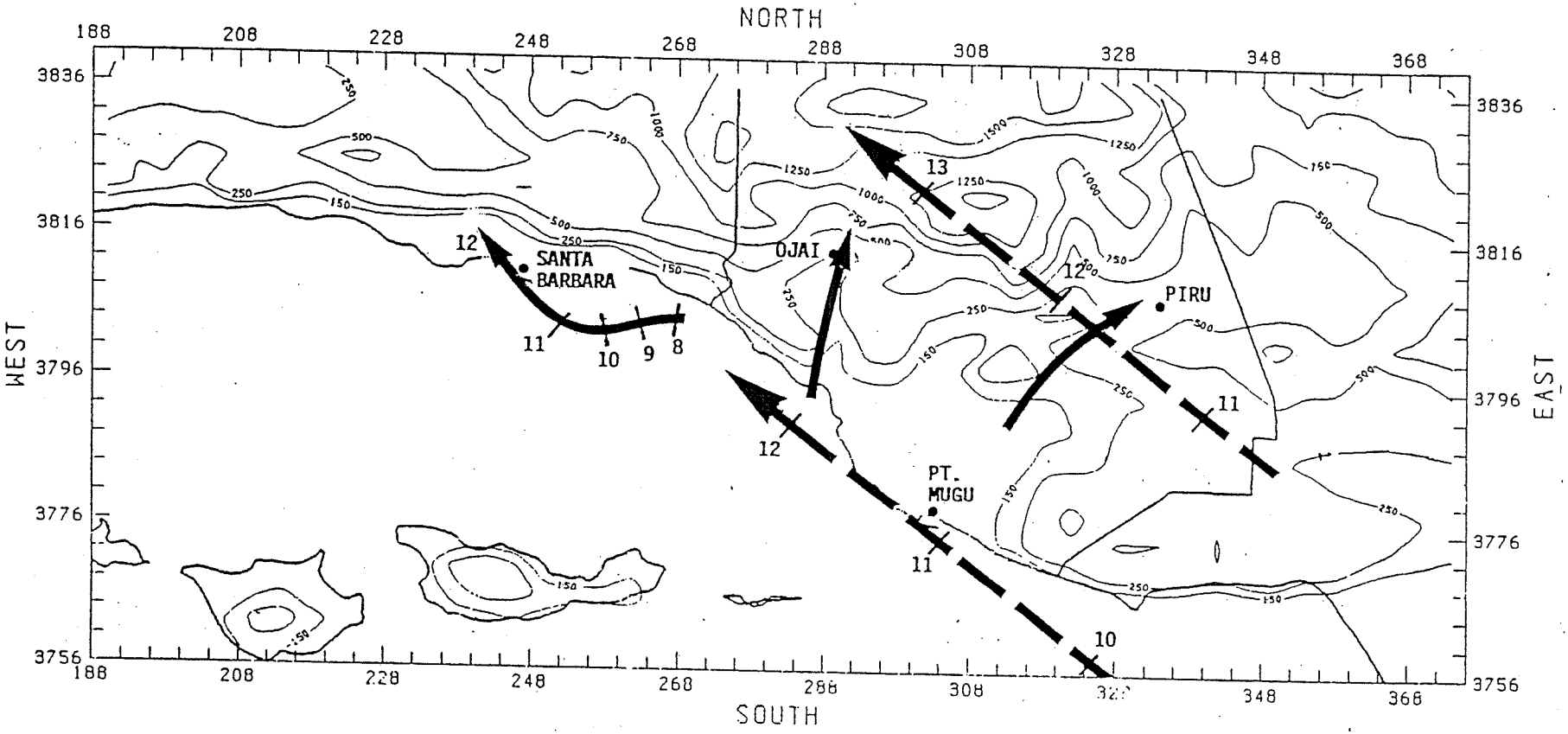

Figure 3-37. Approximate Surface and Elevated Trajectories for September 12, 1983 (Solid lines are surface trajectories and dashed lines are elevated (700m - 1200m) trajectories. Hours shown are PST.)

ozone layer was mixed downward to the surface layers and influenced the surface ozone concentrations. Simi and Rocketdyne, with a southeast wind, were observation stations where the peak concentration could be associated with direct surface transport from the southeast.

In the Santa Barbara area the surface trajectory prior to the peak ozone at 1200 PST suggests that the ozone resided in the eastern portion of the channel in the early morning hours. Winds during the night at Platform Habitat were calm to very light with a general flow from the east. It is therefore possible that the ozone at Santa Barbara resulted from coastal emissions along the Ventura Coast on the 11th which drifted slowly offshore during the night. Subsequently, the pollutant cloud was transported westward through Goleta and El Capitan Beach.

3.3.3 September 18, 1983

3.3.3.1 General Meteorology

On September 18th, a significant low pressure center was present immediately west of Seattle (Figure 3-38). This center moved southeastward during the next 24 hours to southern Wyoming, with the cold front from the low center extending to the west through central California. Falling surface pressures in the inland areas resulted in onshore pressure gradients during the day on the 18th, but these were reversed in northern California by the morning of the 19th. High pressures aloft (500 mb) which had dominated in the southwest since September 11th were eroding rapidly with the approach of the low pressure trough. The principal high pressure area at 500 mb was centered over Baja California, well to the south of southern California.

Low clouds were present throughout the day at Pt. Mugu until 2000 PST. Generally overcast skies were reported except for broken conditions between 1100 and 1400 PST. Broken to overcast clouds were also recorded at Oxnard except for a brief period of scattered clouds from 1400-1500 PST. Santa Barbara also had low overcast clouds for the early part of the day, but these cleared to a scattered sky condition or less by 0900 PST. Visibilities at Pt. Mugu were 3 miles or less throughout the entire 24-hour period on the 18th.

Significant meteorological parameters for September 18, 1983 are shown in Table 3-15.

By September 18th the temperature at 850 mb had decreased by more than $3^{o}C$ from the values observed on September 12th but remained well above average. The surface pressure gradients from central California southward had increased substantially such that there was an increased onshore flow. The inversion base at Pt. Mugu was considerably higher than observed on September 12th but south to southeasterly winds continued at 1000 m agl within the temperature inversion.

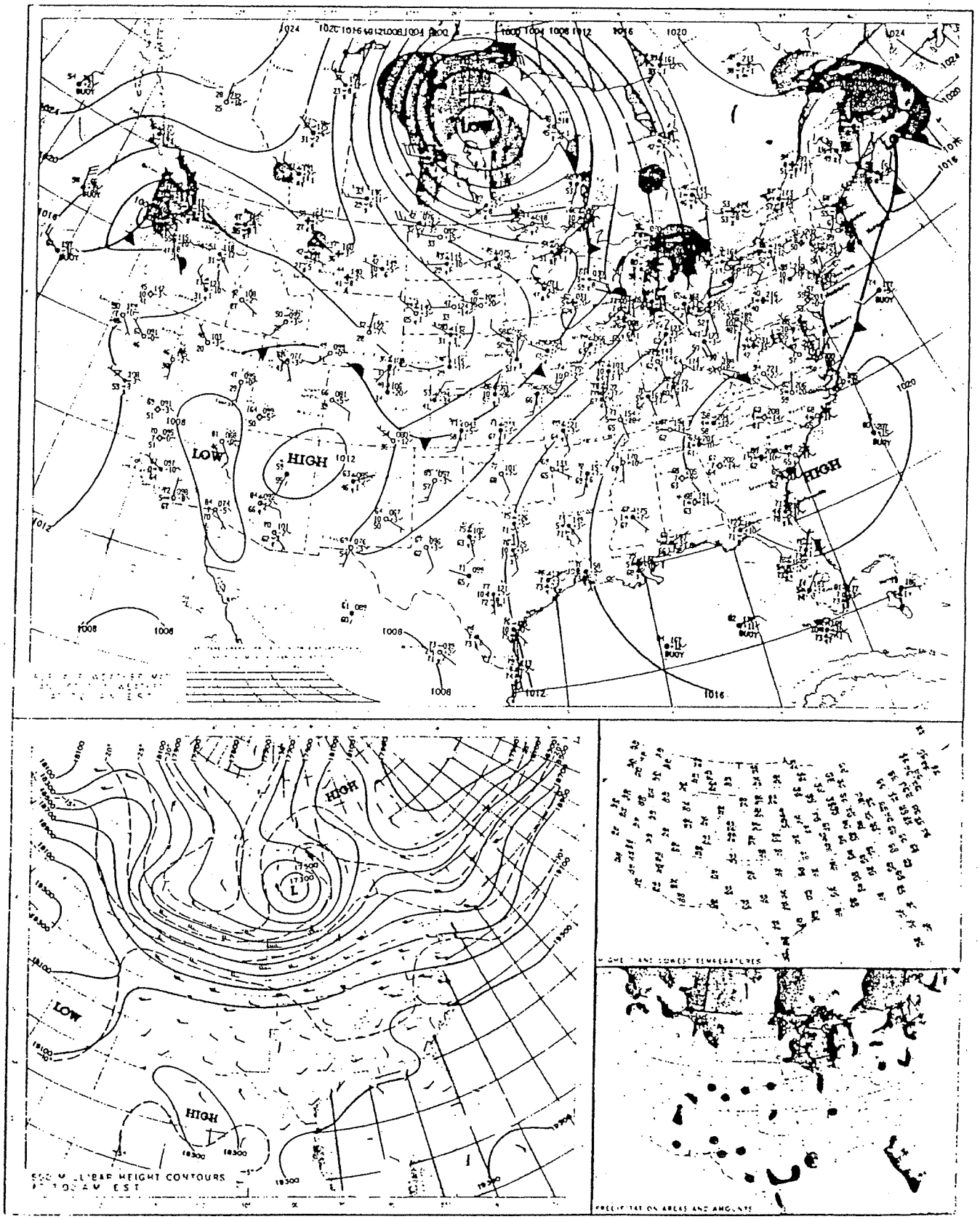

Figure 3-38. Surface and 500 mb Synoptic Weather Maps for 18 September 1983 at 0400 PST.

Table 3-15. Meteorological Parameters for September 18, 1983

	9/18/83	Long Term Average*
850 mb temperature at 0400 PST at Vandenberg AFB	22.1°C	18.1°C
Surface Pressure Gradients (0400 PST)		
San Francisco-Reno	-0.7 mb	-1.2 mb
Los Angeles-Bakersfield	0.2	-0.1
Los Angeles-Las Vegas	2.9	1.6
Inversion Base		
Pt. Mugu (1055 PST)	310 m agl	
Pt. Mugu (1228 PST)	322	
Pt. Mugu (1355 PST)	411	
Upper Winds (1000 m agl)		
Pt. Mugu (1055 PST)	117°/2.5 m/s	
Pt. Mugu (1228 PST)	143°/3	
Pt. Mugu (1355 PST)	182°/1.5	

*average September values (1980-83).

3.3.3.2 Transport Winds

Table 3-16 gives the surface wind observations for a number of locations on September 18th:

Table 3-16. Surface Transport Wind Summary for September 18, 1983

Time (PST)	Laguna Peak (deg./m/s)	Platform Grace (deg./m/s)	Pt. Mugu (deg./m/s)	Santa Barbara (deg./m/s)
0600	150/2	036/2.0	calm	030/2
0800	90/3	348/2.0	010/1	calm
1000	130/3	221/1.0	200/2	170/3
1200	160/2	265/2.6	250/2	220/3
1400	140/4	234/3.7	280/3	230/5
1600	150/3	246/2.6	280/3	190/2
1800	80/3	245/2.6	300/2	230/2
2000	110/3	260/2.6	300/2	190/4
2200	calm	242/2.3	320/2	250/2

The doppler acoustic sounder wind observations at Simi for September 18th are summarized in Table 3-17:

Table 3-17. Doppler Acoustic Sounder Winds at Simi at 1000 m msl for September 18, 1983

Time (PST)	Wind (deg./m/s)	Time (PST)	Wind (deg./m/s)
0800	119/4.9	1600	187/1.6
1000	162/9.8	1800	181/1.7
1200	127/3.6	2000	146/2.3
1400	155/3.2	2200	133/4.2

3.3.3.3 Mixing Heights

Observed mixing heights as obtained from aircraft spirals on September 18th are shown in Table 3-18.

Table 3-18. Mixing Heights from Aircraft Soundings on September 18, 1983

	Time (PST)	Mixing Depth (m agl)
Camarillo (sfc. elev. 25 m)		
	0550	150
	1029	375
	1440	450
Pt. 2 (3 mi SSW Laguna Peak)		
	0610	stratus
	1041	250
	1451	(350) top of stratus
Pt. 3 (13 mi SSW Laguna Peak)		
	0635	stratus
	1103	400
	1514	400
Westlake Reservoir (sfc. elev. 305 m)		
	0714	425
	1143	650
	1608	725
Simi (sfc. elev. 335 m)		
	0735	400
	1202	600
	1625	650

The higher mixing heights on September 18th reflected a return to more normal onshore flow conditions and a decrease in the temperatures aloft. Associated with these changes were the more prevalent stratus cloud conditions over the water.

3.3.3.4 Regional Ozone Concentrations

Maximum ozone concentrations in the South Central Coast Air Basin on September 18th are given in Table 3-19 together with the hours when the peak concentrations occurred and the time of maximum occurrence.

Maximum ozone concentrations on September 18th were relatively high in the inland and elevated areas such as Simi, Rocketdyne, and Laguna Peak. Peak concentrations along the coast were relatively low. As suggested later, this configuration is characteristic of deeper mixing layers than occurred on September 11-12th.

3.3.3.5 Transport Analysis

Figure 3-39 gives the hourly ozone concentrations at several locations in Ventura County for September 18, 1985. At Ojai, Piru and Simi, the peak

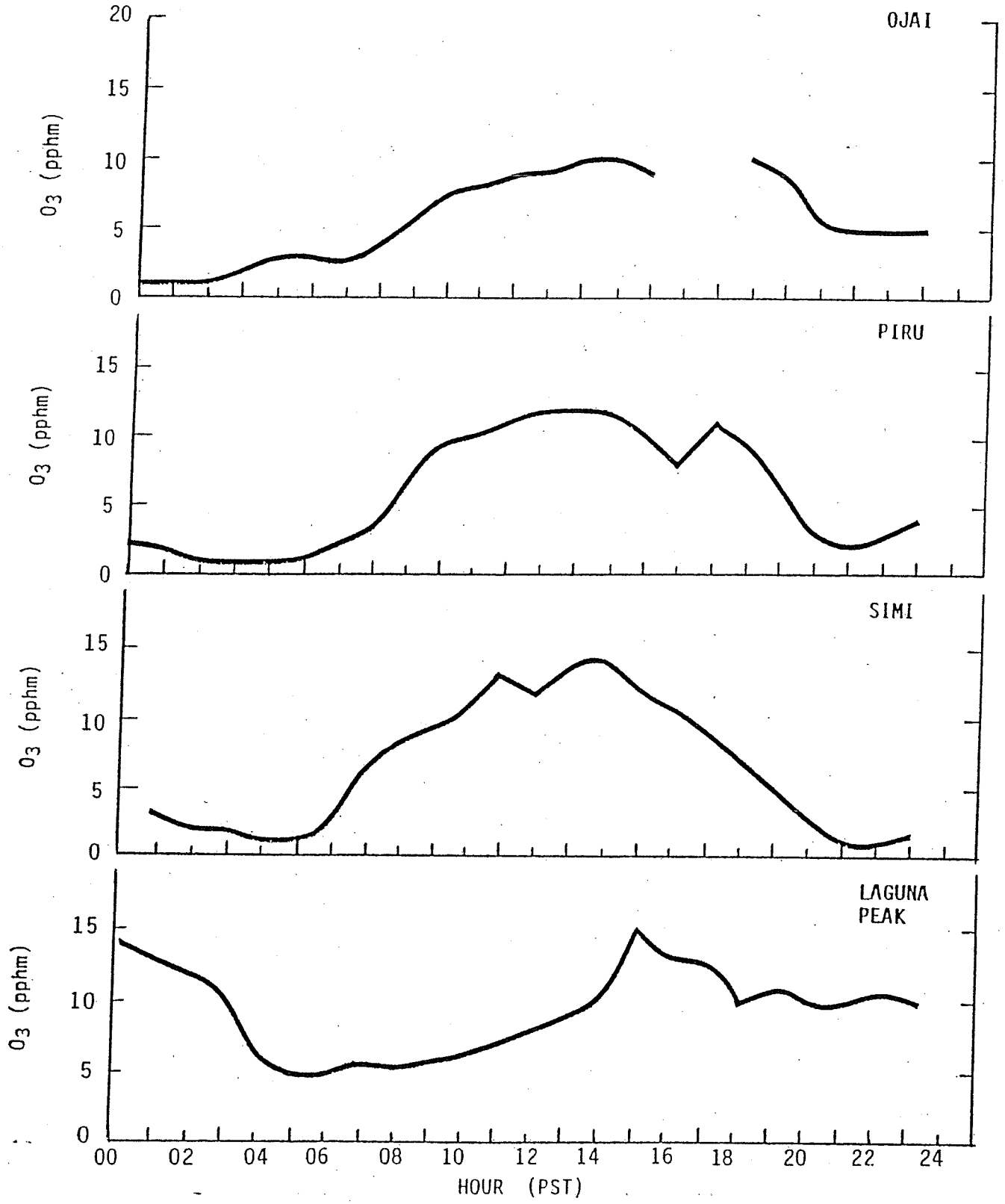

Figure 3-39. Hourly Average Ozone Concentrations for 18 September 1983.

Table 3-19. Maximum Ozone Concentrations on September 18, 1983

Location	Maximum Concentration (pphm)	Time of Maximum (PST)	Wind (^{o}/m/s)
Ojai	10	13-14,18	200/334/4
Piru	12	12-14	249/M
Simi	15	14	281/4
Thousand Oaks	10	12-13	
Rocketdyne	14	13-14	159/3
El Rio	7	9-11,13	
Laguna Peak	15	15	170/2
Ventura	M	M	
La Conchita	4	12-17	
Santa Barbara	6	16	190/2
Goleta	6	14-15	
El Capitan Beach	6	13-17	

ozone occurred between 1200 and 1400 PST. A second peak was apparent at Ojai and Piru but not at Simi. The highest ozone concentration at Laguna Peak was recorded at 1500 PST. In consideration of the east to southeast flow which was present throughout the day at Laguna Peak, the ozone maximum at 1500 PST was probably the result of transport from the Los Angeles area. From the standpoint of progressive transport of this peak farther into the South Central Coast Basin, the late peaks at Piru and Ojai are in agreement with such a hypothesis.

High ozone concentrations were observed at Laguna Peak throughout the night of September 17th-18th. The influx of ozone at that location commenced at 1800 PST on the 17th under northwestly winds. A peak value of 15 pphm was observed at 2200 PST. At about the same time, the wind shifted to east and southeast with high speeds (0-2 m/s) where it remained for the balance of the night. There was therefore a layer of ozone at 450 m msl available on the morning of the 18th, at least in the vicinity of Laguna Peak.

At the observing locations in Santa Barbara County on the 18th, peak ozone values were 6 pphm and were not influenced by any transport from the southeast.

Figure 3-40 shows the early morning aircraft sounding at Camarillo on September 18th. The peak ozone recorded was 8 pphm in an elevated layer of ozone and particles (b_{scat}) which was present above about 500 m msl. Presumably this layer may have been part of the same pollutant layer observed at Laguna Peak during the night and early morning hours. The sounding in Figure 3-41 was taken at Pt. 2 (3 mi SSW of Laguna Peak). The presence of stratus clouds eliminated the lower part of the sounding, and a maximum ozone concentration of 10 pphm was observed above the stratus.

Figures 3-42 and 3-43 give the soundings at Westlake Reservoir and Simi on the early morning flight. In both soundings two aerosol layers were

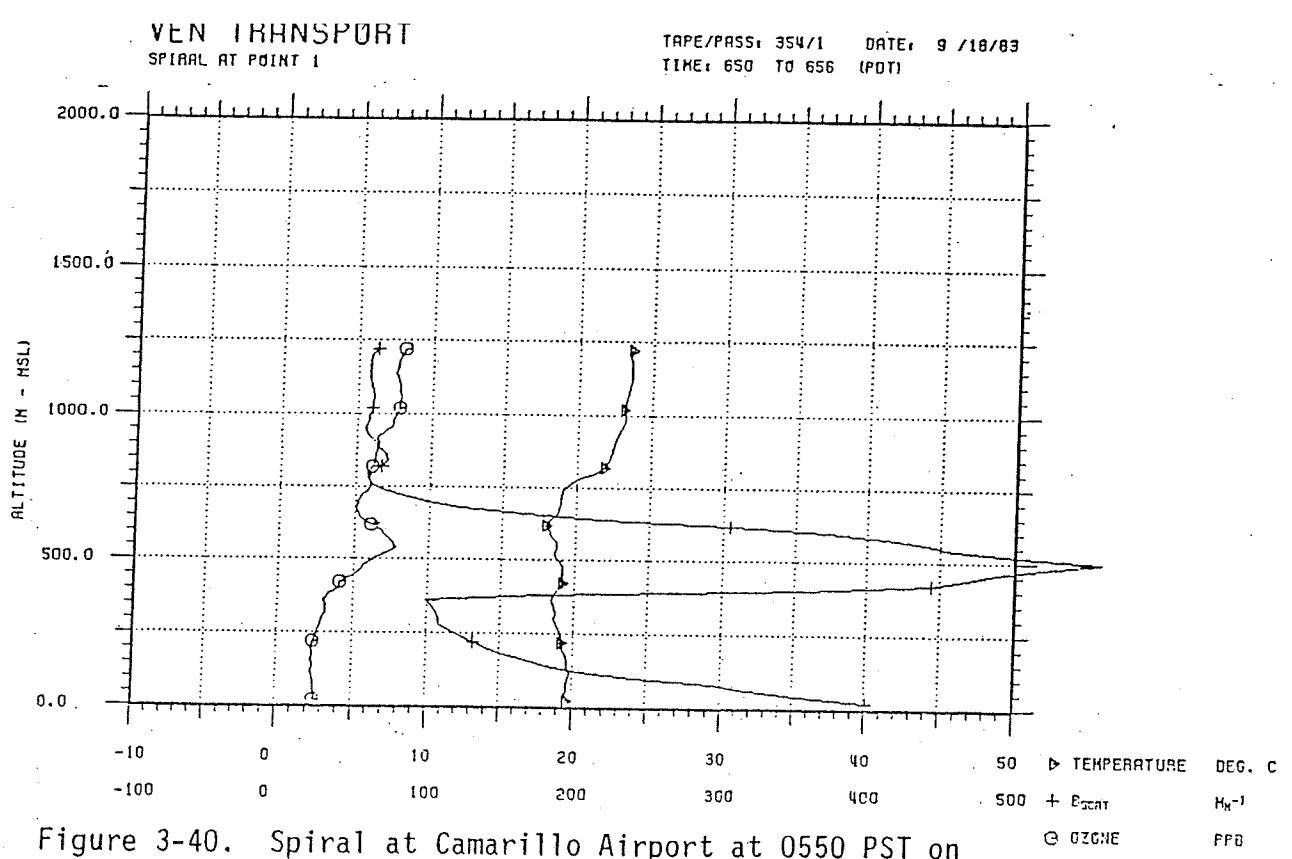

Figure 3-40. Spiral at Camarillo Airport at 0550 PST on September 18, 1983.

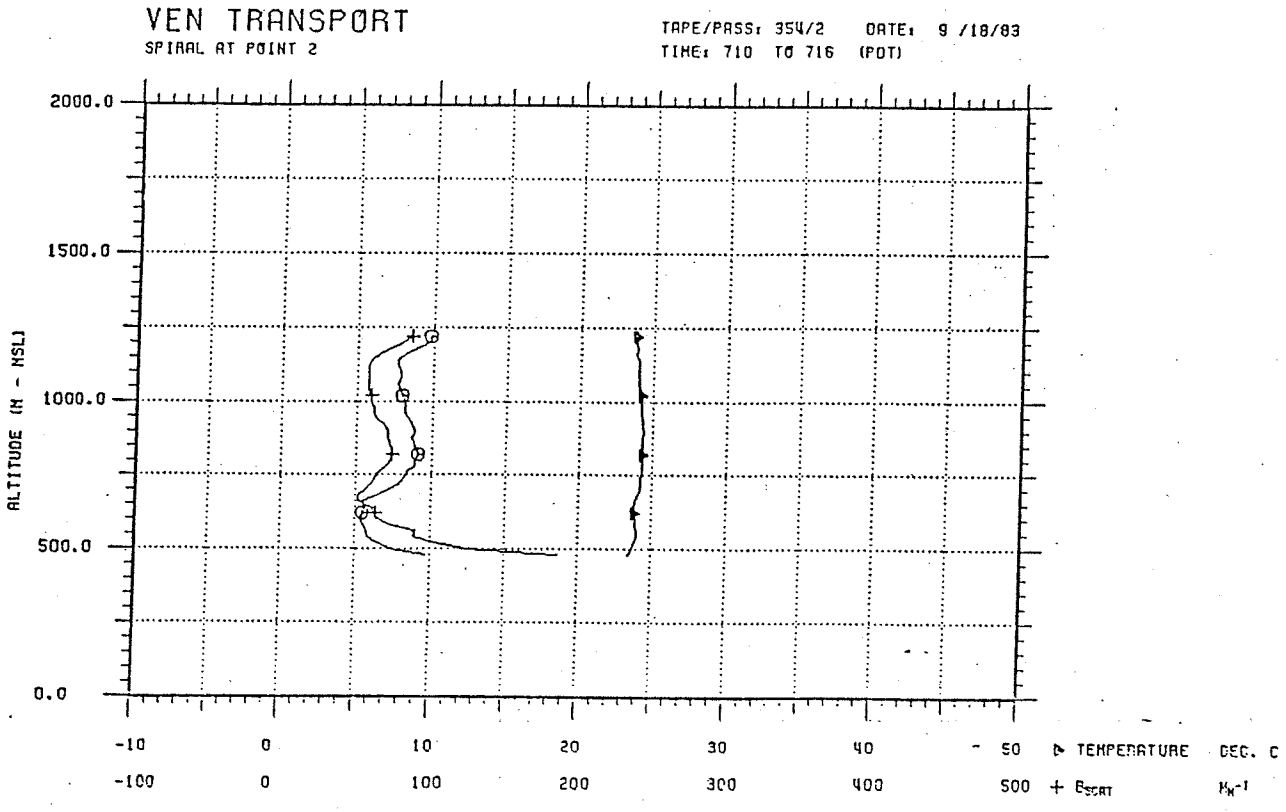

Figure 3-41. Spiral Offshore of Laguna Peak at 0610 PST on September 18, 1983.

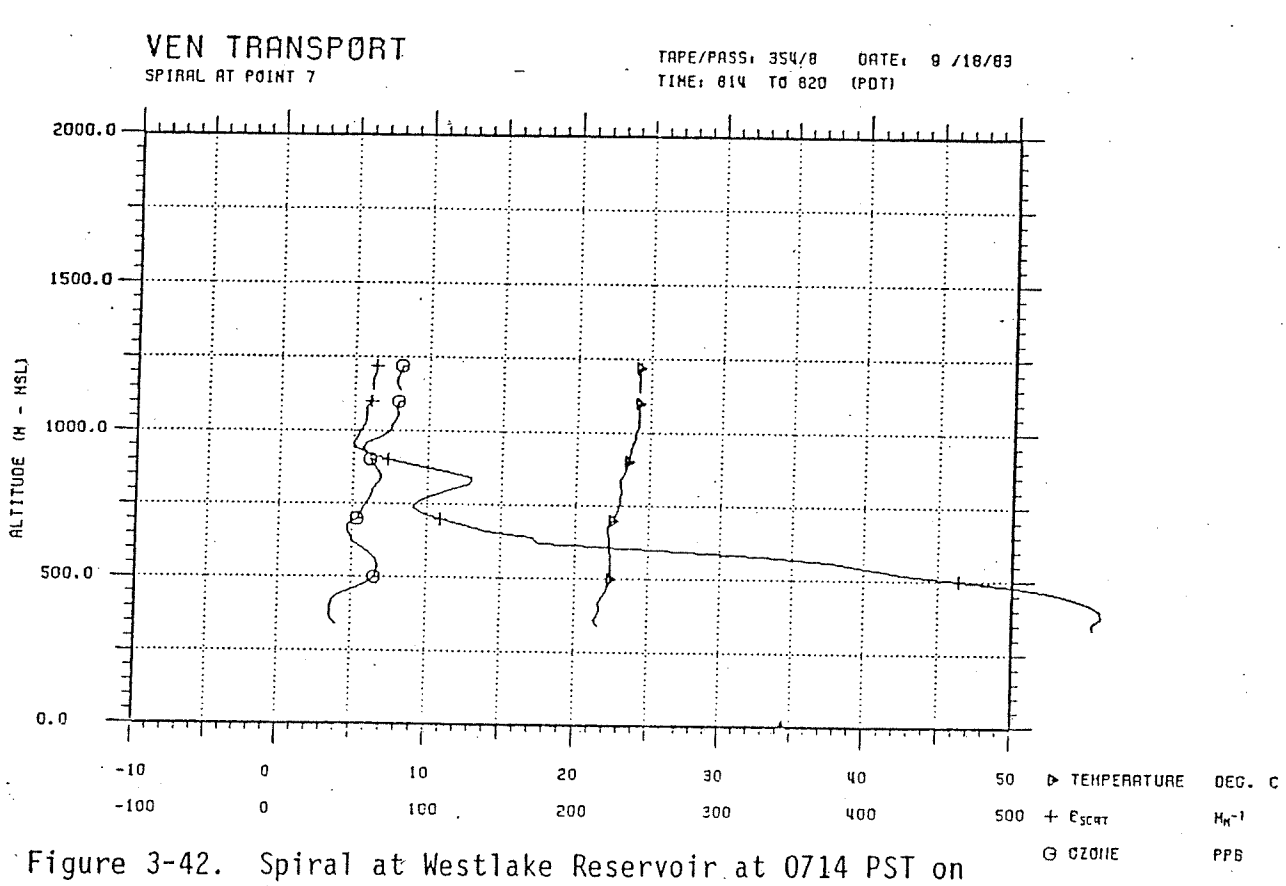

Figure 3-42. Spiral at Westlake Reservoir at 0714 PST on September 18, 1983.

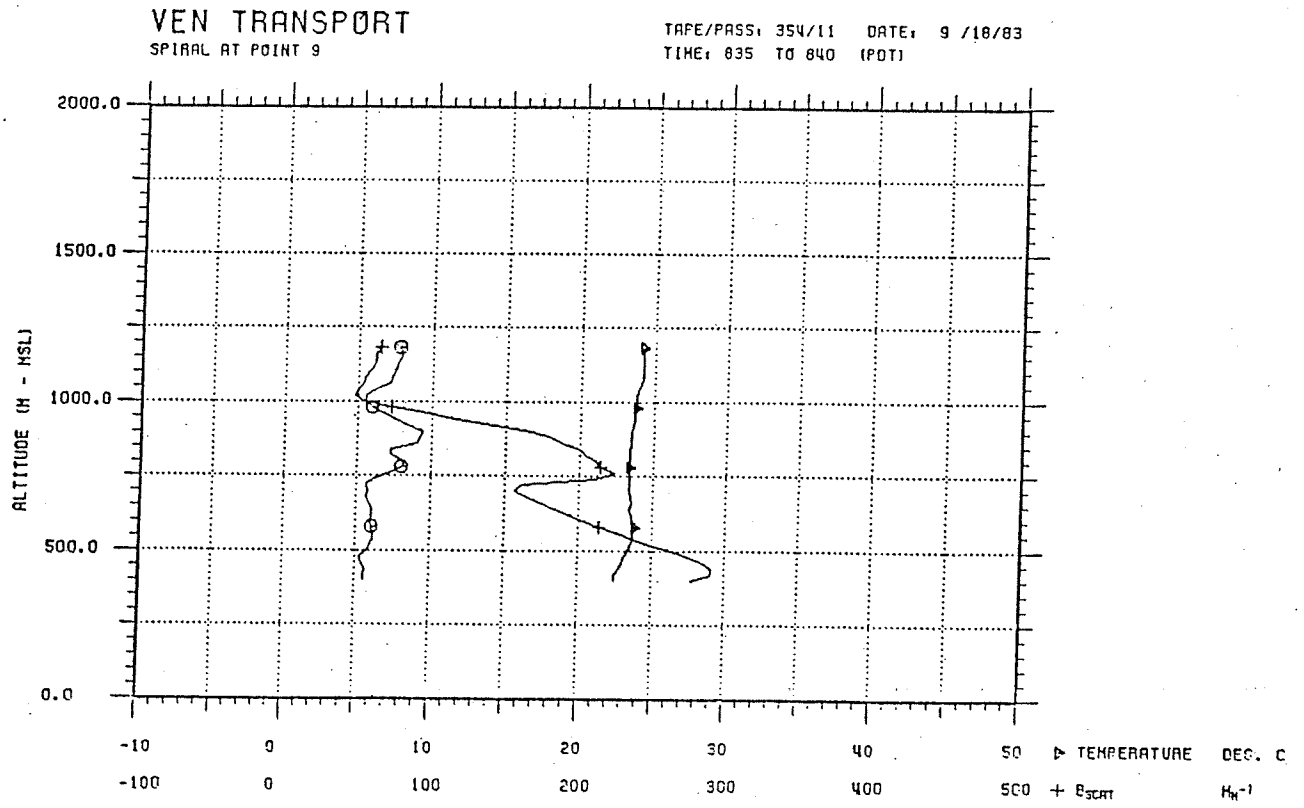

Figure 3-43. Spiral at Simi at 0735 PST on September 18, 1983.

observed below 1000 m msl which is the approximate height of much of the Simi Hills ridge line. A similar profile is shown for Piru in Figure 3-44 except that ozone concentrations of 11 pphm were observed at about 400 m msl. In view of the similar observations at Camarillo, Laguna Peak and the inland locations, it is suggested that these upper layers represented carryover of pollutants from the previous day as well as nocturnal transport from the southeast.

The effect of this layer aloft at Piru is shown in Figure 3-45. The time history of hourly ozone at Piru on September 18th shows a sharp increase from 0800 to 0900 PST which appears to represent the mixing downward of the ozone aloft which was shown in Figure 3-44. Although the wind directions at Rocketdyne and Piru were both easterly or southeasterly, the ozone increase at Rocketdyne was not as sharp as at Piru and did not occur until an hour after the increase at Piru. It is therefore suggested that mixing down of pollutants from the previous day was the likely cause of the increase at Piru.

Figures 3-46 and 3-47 show midday soundings at Westlake Reservoir and Simi. The soundings show well-mixed layers to at least 600 m msl with little change in ozone concentration above this level. The ozone concentrations and wind direction at Rocketdyne at the time of the Simi sounding indicate that the concentrations aloft were being transported into the area from the southeast.

Figure 3-48 shows the late afternoon sounding at Camarillo. On this sounding, there was a well-mixed layer to 500 m msl with moderately low ozone concentrations. Aloft, the ozone concentrations increased within the inversion to 13 pphm at 750 m msl. This represents an increase from 9 pphm at that level on the midday sounding.

Figure 3-49 shows the late afternoon sounding at Pt. 2 (3 mi SSW of Laguna Peak). This sounding indicates that a major ozone layer had advected into the area between 300 and 650 m msl. A peak ozone value of 34 pphm was recorded in this layer at 450 m msl. As indicated, the layer was located within the temperature inversion.

Figure 3-50 is a horizontal traverse from Pt. 2 to Pt. 3 at 396 m msl. The data show that the high ozone concentrations did not extend as far offshore as Pt. 3 but were confined to regions closer to the coast. This is further confirmed by the sounding at Pt. 3 (Figure 3-51) which showed a maximum ozone concentration of 11 pphm.

Afternoon aircraft soundings at Westlake Reservoir and Simi are shown in Figures 3-52 and 3-53. Both soundings show a marked, low-level mixing layer to about 750 m msl. This layer was characterized by southwest winds and transport from the west. Aloft there is a large difference in ozone concentrations between the two soundings with much higher values at Simi. Winds at these levels were from the southeast so that the high concentrations at Simi represent transport from the San Fernando Valley which did not affect the Westlake area.

Figure 3-54 is a sounding made at Santa Paula at 1657 PST which shows the major effect of the transport of the ozone layer shown in Figure 3-49. An ozone layer was present in the Santa Paula sounding from 250 to 700 m msl with a peak value of 24 pphm at 400 m msl. This layer was undercut by a

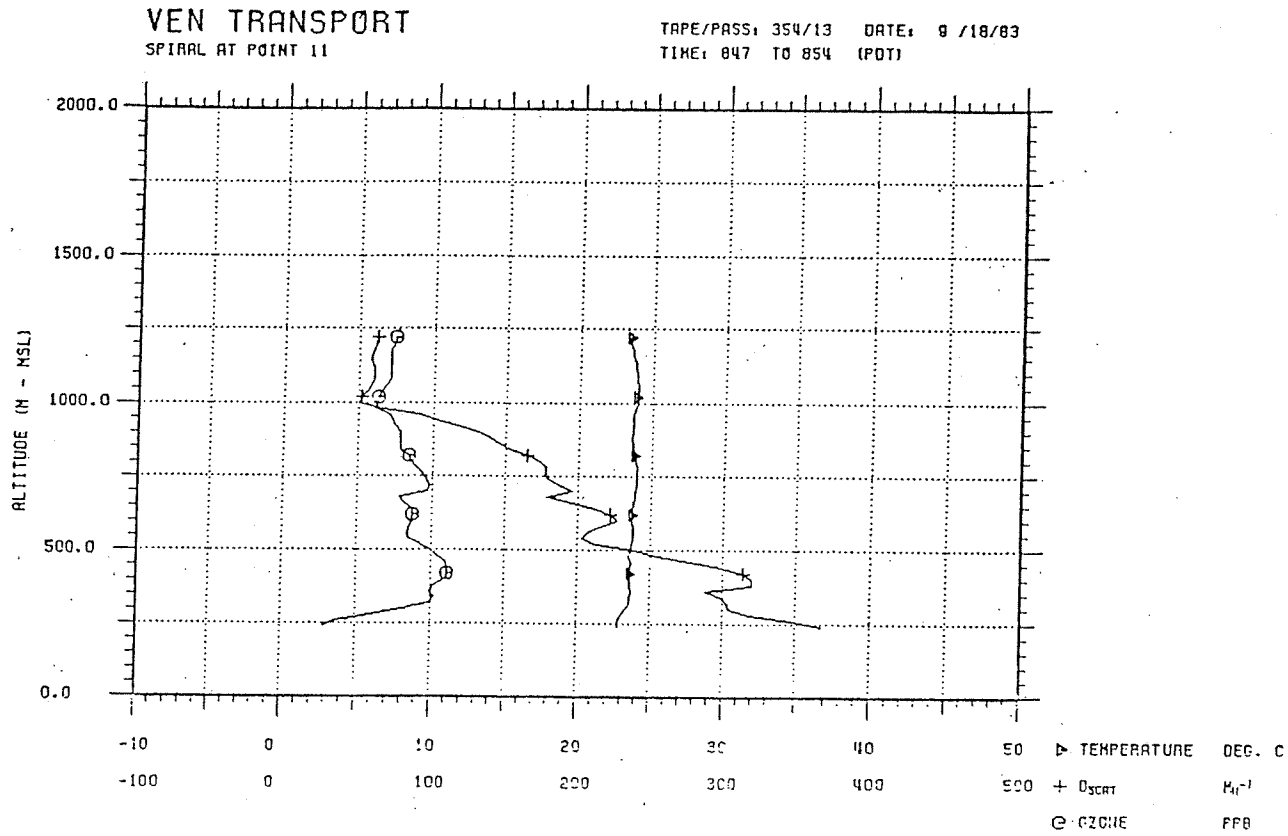

Figure 3-44. Spiral at Piru at 0747 PST on September 18, 1983.

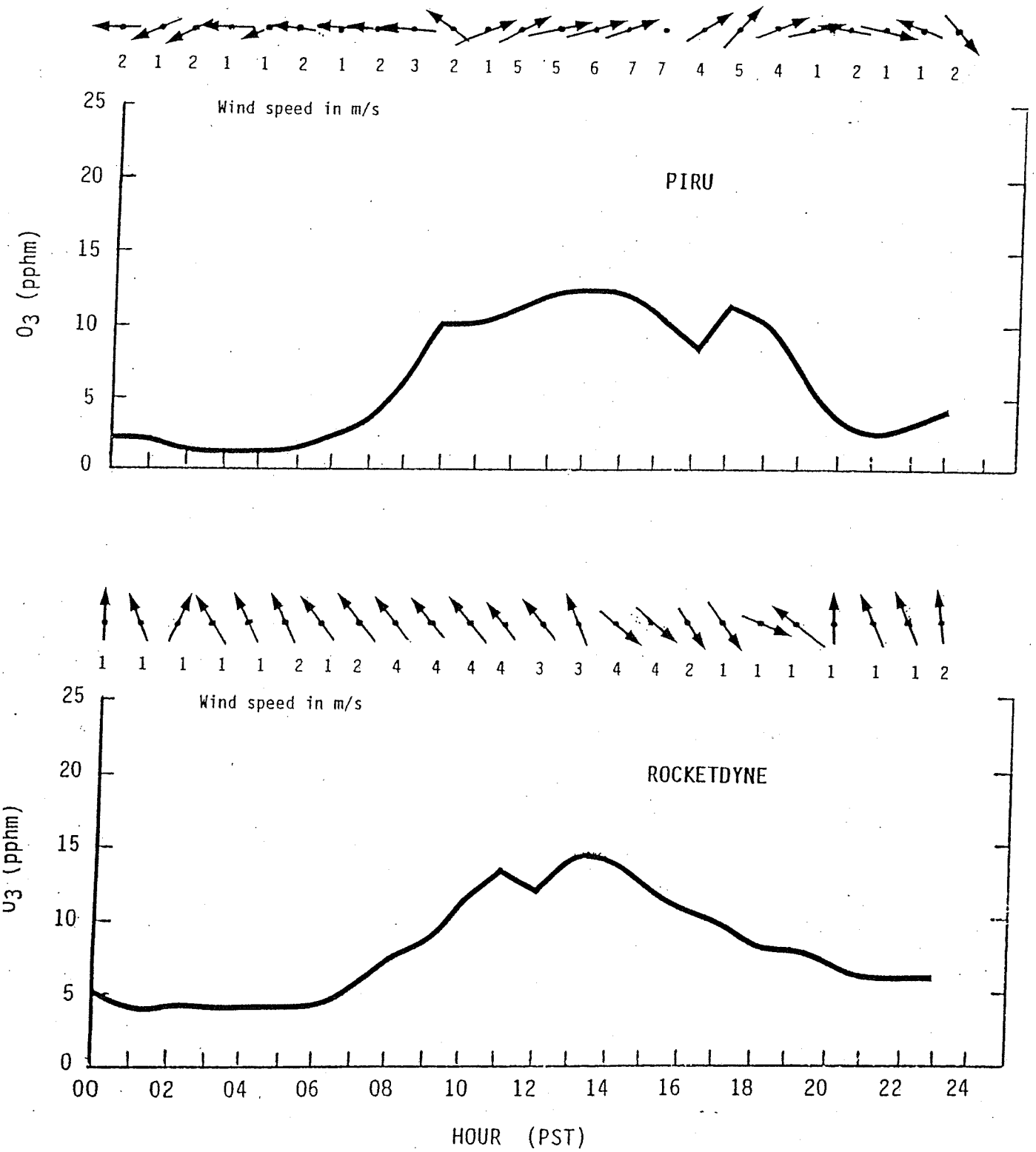

Figure 3-45. Hourly Ozone, Wind Speed, and Wind Direction at Piru and Rocketdyne on 18 September 1983.

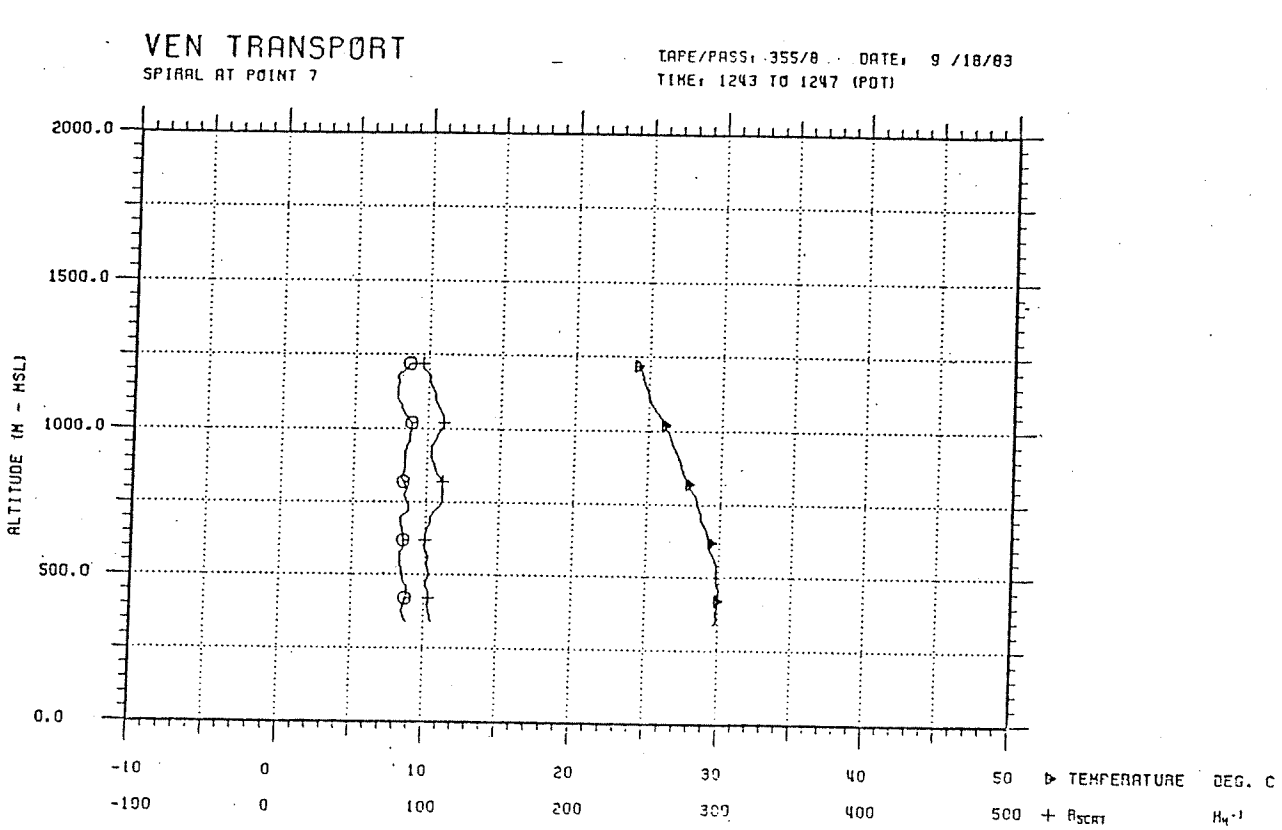

Figure 3-46. Spiral at Westlake Reservoir at 1143 PST on September 18, 1983.

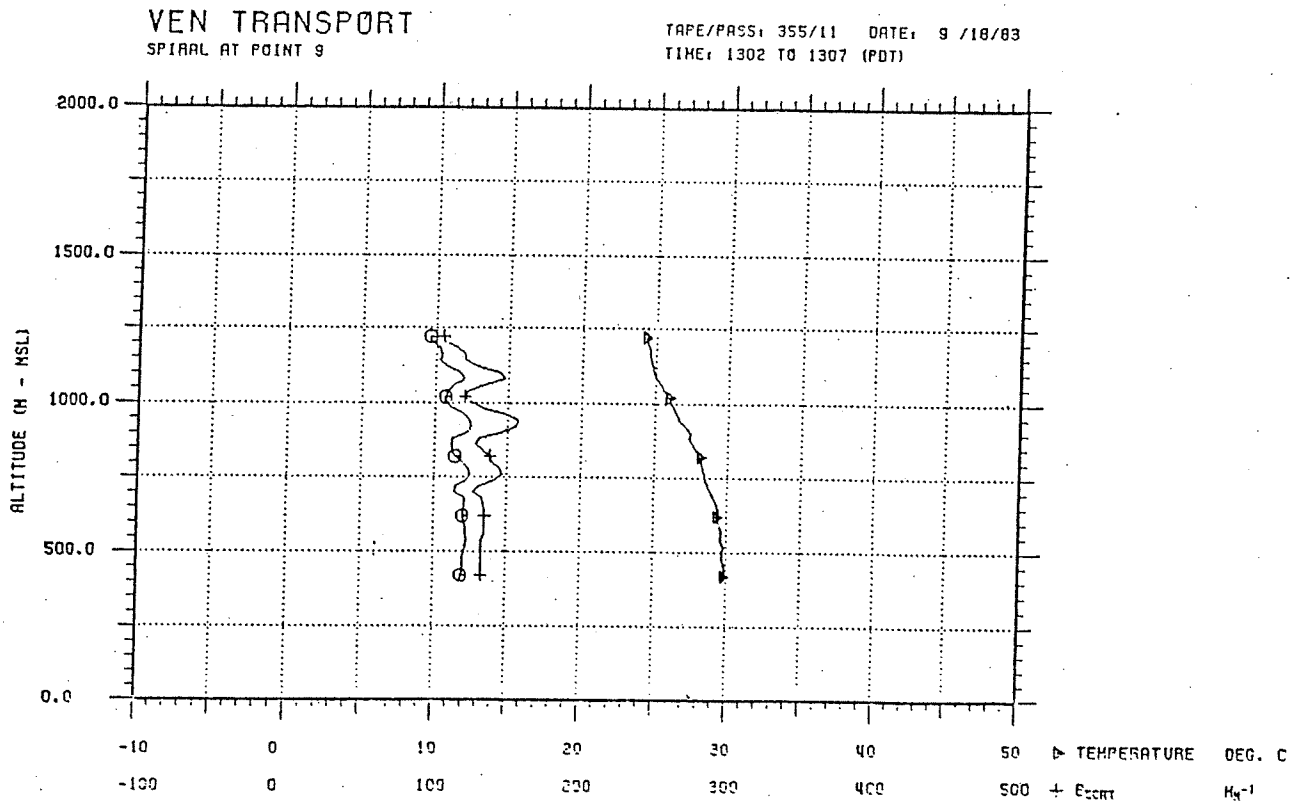

Figure 3-47. Spiral at Simi at 1202 PST on September 18, 1983.

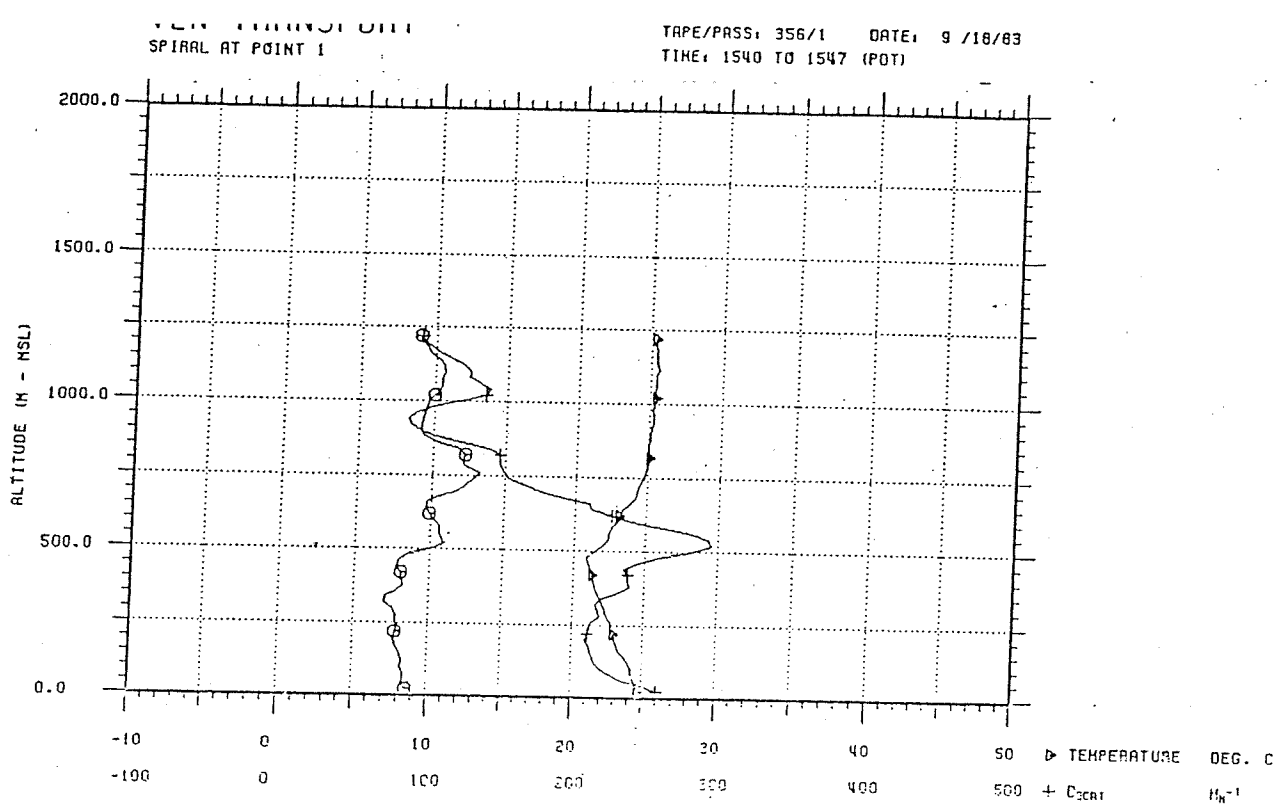

Figure 3-48. Spiral at Camarillo Airport at 1440 PST on September 18, 1983.

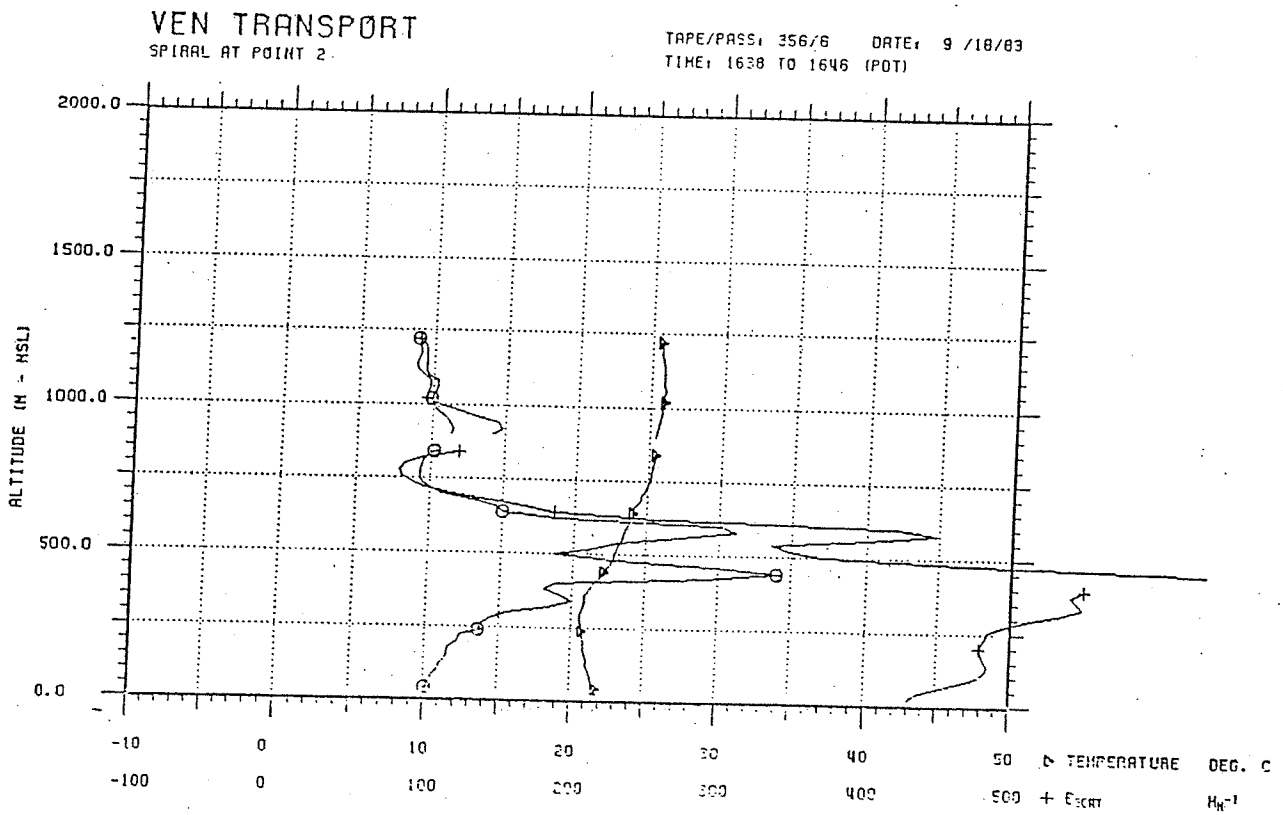

Figure 3-49. Spiral Offshore of Laguna Peak at 1538 PST on September 18, 1983.

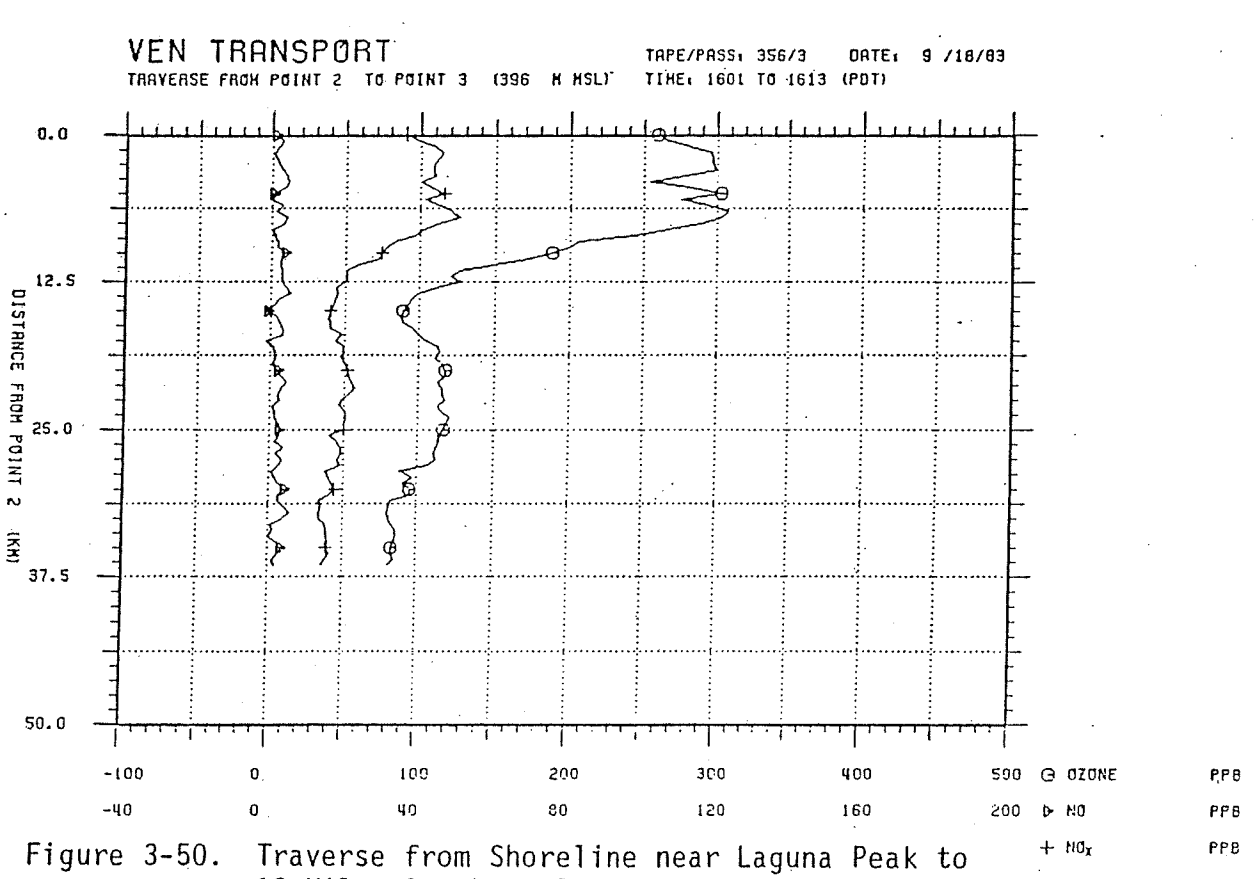

Figure 3-50. Traverse from Shoreline near Laguna Peak to 10 Miles South of Pt. Mugu at 1501 PST on September 18, 1983.

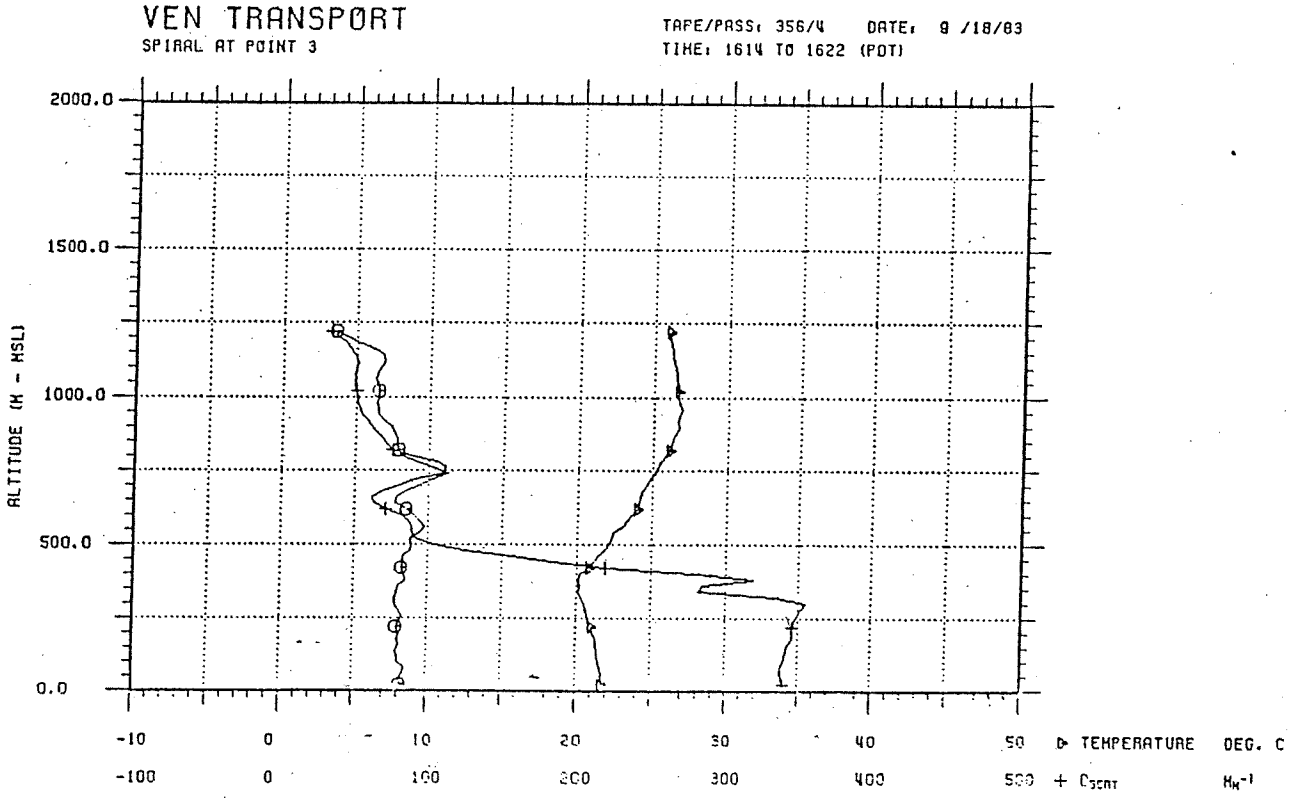

Figure 3-51. Spiral at 10 Miles South of Pt. Mugu at 1514 PST on September 18, 1983.

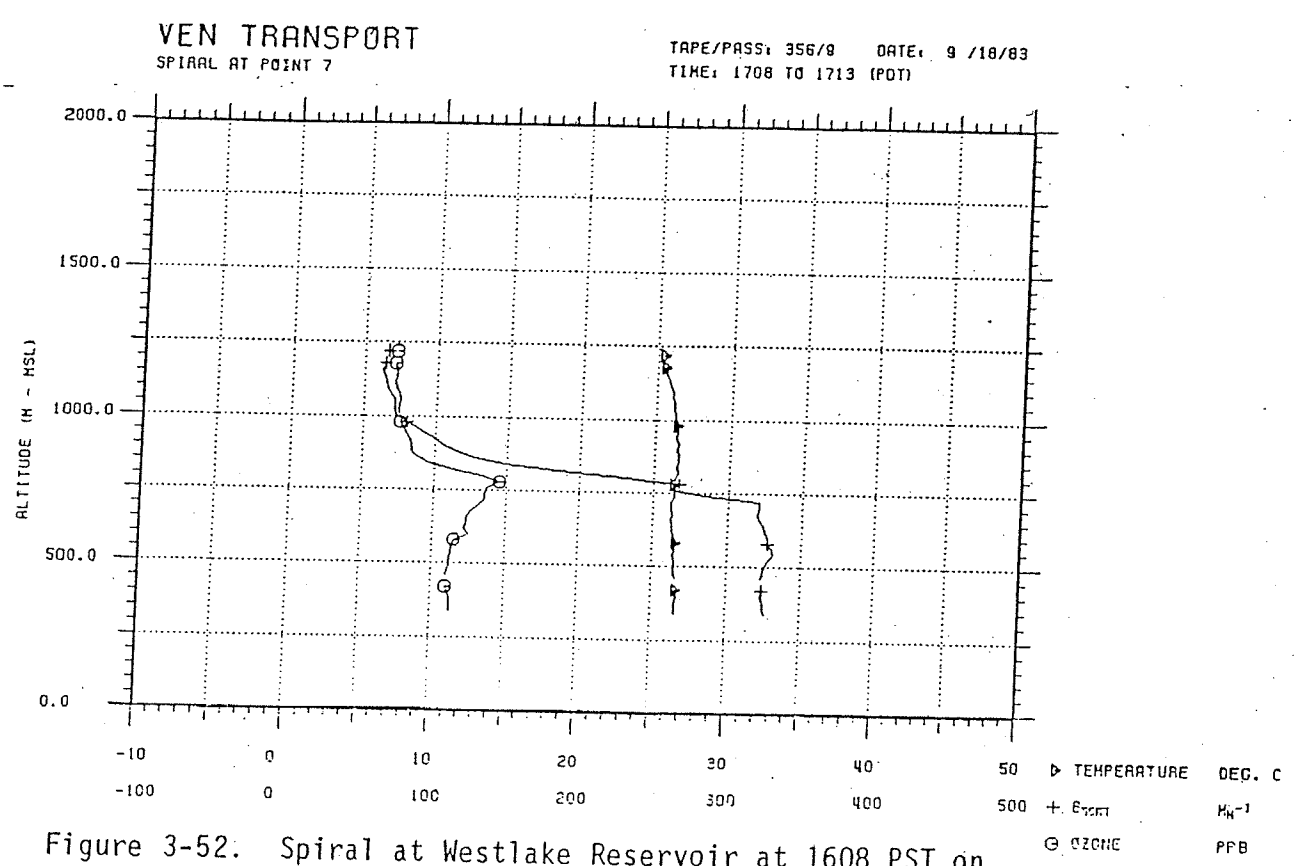

Figure 3-52. Spiral at Westlake Reservoir at 1608 PST on September 18, 1983.

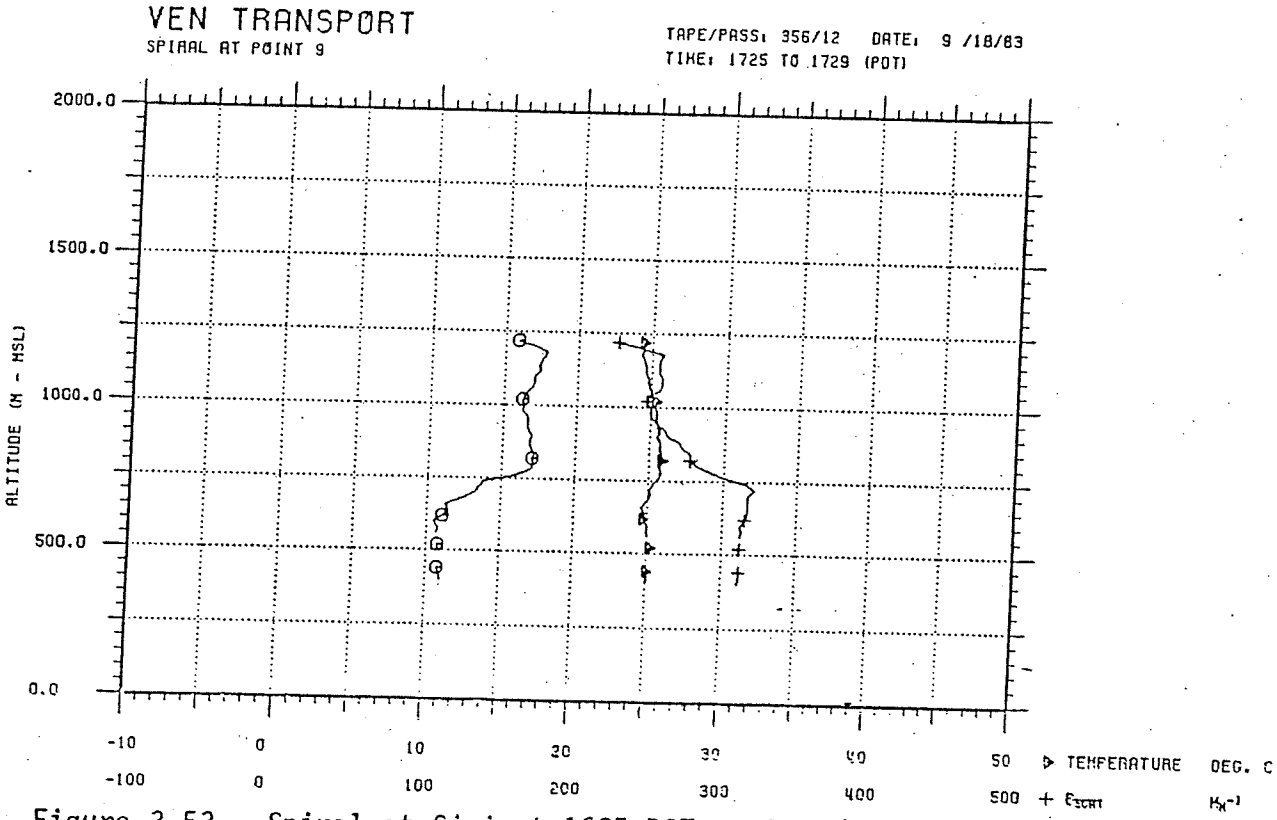

Figure 3-53. Spiral at Simi at 1625 PST on September 18, 1983.

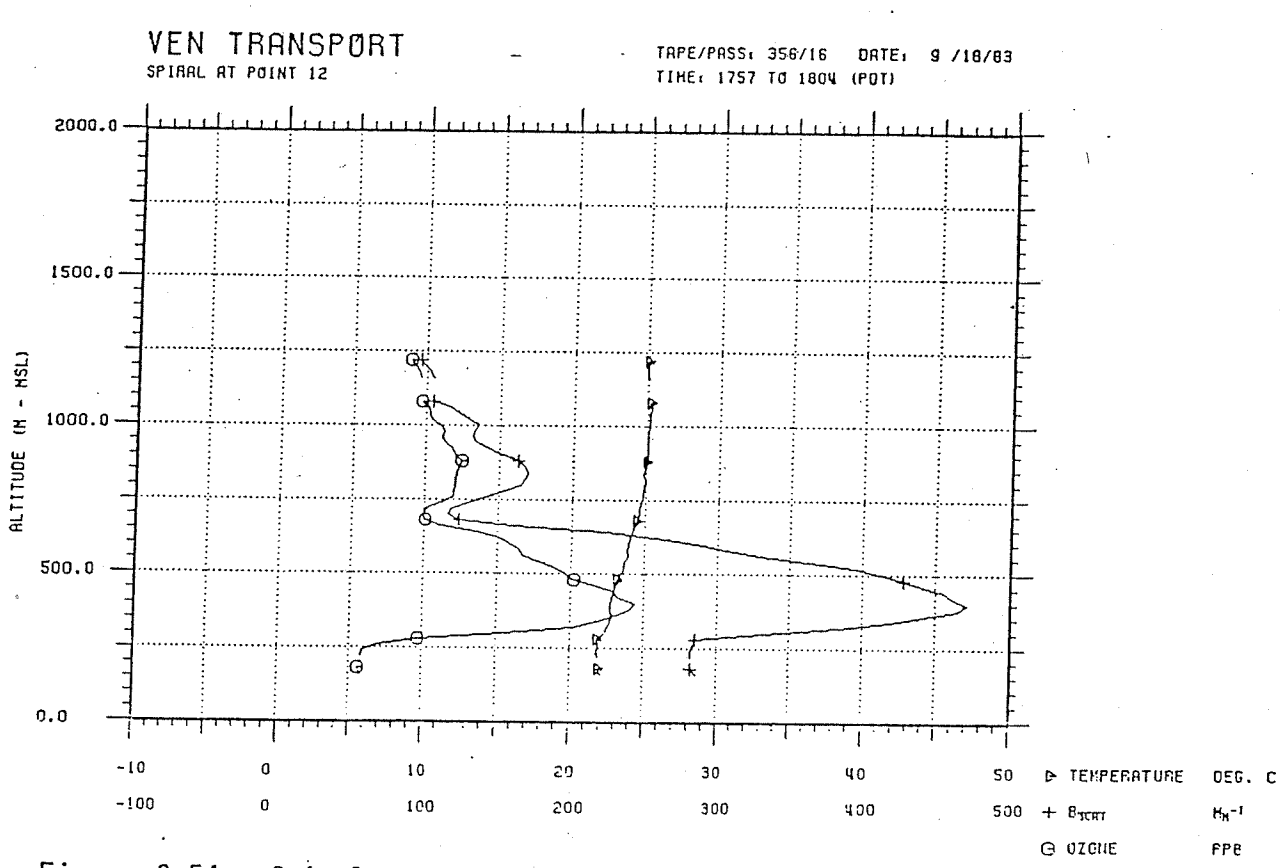

Figure 3-54. Spiral at Santa Paula at 1657 PST on September 18, 1983.

shallow (200 m) layer of cool, marine air which prevented the upper ozone concentrations from reaching the surface. Farther inland (Ojai and Piru) surface heating increased and the effect of these concentrations was seen at the surface in terms of the late afternoon ozone peaks at the two locations (Figure 3-39).

The transport conditions of September 18th are summarized in Figure 3-55. A major transport route offshore was observed from the South Coast Air Basin into the South Central Coast Basin. The main portion of the transport occurred rather late in the day with peaks extending from Laguna Peak (1500 PST) to Piru and Ojai (1600-1700 PST). Aircraft soundings at Pt. 2 and Santa Paula supported the description of this transport route.

3.4 SUMMARY OF SEPTEMBER 1983 CASE STUDIES AND METEOROLOGY-OZONE RELATIONSHIPS IN VENTURA COUNTY

Three cases of transport from the South Coast Air Basin into the South Central Coast Air Basin have been described in the previous section. A brief summary and comparison of these cases follows:

1. September 11, 1983

   850 mb temperature: 24.5°C
   Offshore pressure gradients
   030° wind direction at 1000 m at Loyola-Marymount (0600 PST)
   Weak seabreeze at Pt. Mugu
   Very low mixing heights
   Peak ozone concentration at Pt. 2 - 26 pphm (1426 PST)
   Maximum surface ozone concentrations higher along coast than inland

   Conclusion:
   a. Pollutants were transported at low-levels from the South Coast into the coastal areas of Ventura County.
   b. Local pollutants from September 10th reimpacted Santa Barbara on the 11th.

2. September 12, 1983

   850 mb temperature: 25.5°C
   Offshore pressure gradients
   132° wind direction at 1000 m at Pt. Mugu (0900 PST)
   Very weak seabreeze at Pt. Mugu
   Low mixing heights
   Peak ozone concentration at Pt. 2 - 22 pphm (1442 PST)
   Maximum surface ozone occurred inland in Ventura County but exceedances also occurred along the coast at Ventura and Santa Barbara

   Conclusion:
   a. Direct transport across Simi Hills into eastern Ventura County occurred.
   b. Pollutants were transported offshore from the South Coast Basin into Ventura and Ojai.
   c. Local pollutants from September 11th reimpacted Santa Barbara on the 12th.

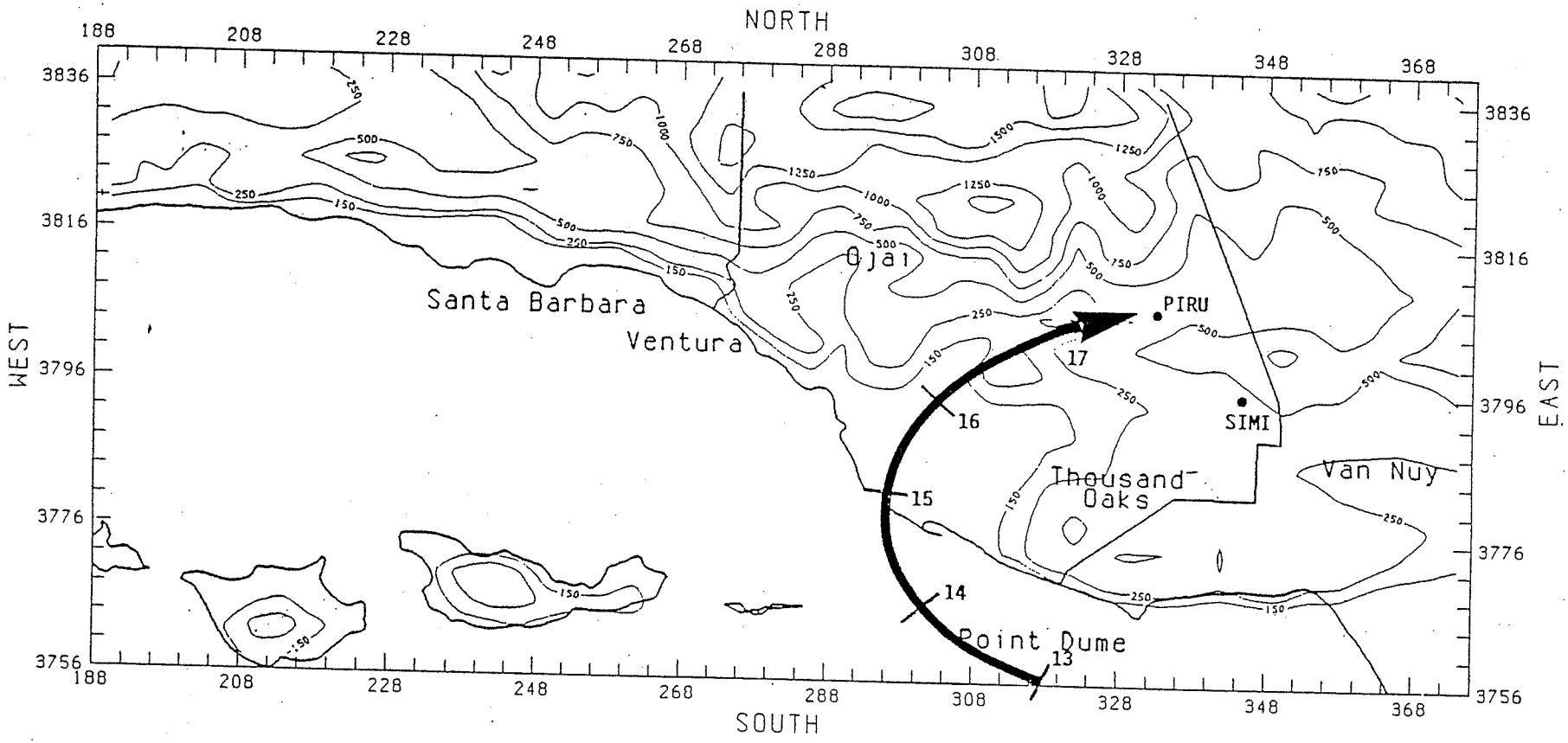

Figure 3-55. Approximate Trajectory Arriving at Piru During the Hour of Maximum Ozone on September 18, 1983. (Hours shown are PST.)

3. September 18, 1983

850 mb temperature: 22.1°C
Offshore pressure gradient Las Vegas-Los Angeles
117° wind direction at 1000 m at Pt. Mugu (1055 PST)
Moderate seabreeze at Pt. Mugu
Moderate mixing heights
Peak ozone concentration at Pt. 2 - 34 pphm (1451 PST)
Maximum surface ozone concentrations occurred inland in Ventura County and at Laguna Peak

Conclusion:
a. Pollutants from September 17th impacted surface concentrations on the 18th through entrainment of a layer aloft.
b. Transport from the South Coast Air Basin into Ojai and Piru occurred.

There are several common features which characterize these transport days. Three of the most important appear to be the occurrence of warm temperatures at 850 mb, offshore winds along the coast at 1000 m in the morning and the appearance of high ozone concentrations at Pt. 2 (3 mi SSW of Laguna Peak). High ozone values at Laguna Peak are also usually associated with southeast winds and transport from the South Coast Air Basin.

The impact of transport into the South Central Coast Basin depends to a great extent on the depth of the associated mixing layer. Shallow mixing depths tend to produce high ozone concentrations along the immediate coast while deeper mixing layers result in a more elevated ozone layer and impact on the higher elevation, inland areas.

A summary of September 1983 days is given in Table 3-20. Included in the table is the 0400 PST Vandenberg AFB 850 mb temperature, the occurrence of morning winds (1000 m) at Pt. Mugu from the northeast through south, the daily peak ozone aloft measured at Pt. 2, and the occurrence of high ozone concentrations at Laguna Peak. These factors should be related to the occurrence or non-occurrence of surface ozone concentrations greater than 12 pphm as indicated.

Several summary comments can be made from Table 3-20.

1. For the month of September 1983, ozone exceedances in Ventura County occurred only with 850 mb temperatures of 21.7°C or more.

2. Exceedances in Ventura County occurred with morning winds (1000 m) at Pt. Mugu between northeast and south. Such winds also occurred on some non-exceedance days but with lower temperatures aloft. The potential for transport from the South Coast Air Basin would be expected under such conditions. The importance of the transport undoubtedly depends on the low-level entrapment of pollutants for which warm temperatures aloft are an indicator. Thus, significant transport of ozone from the South Coast Basin should usually be accompanied by the concurrence of northeast to south Pt. Mugu winds and warm temperatures aloft.

Table 3-20. Summary of September 1983 Data

	Ventura	Laguna Peak	El Rio	Piru	Simi	Vandenberg AFB 0400 PST 850 mb temp. (°C)	Pt. Mugu 1000m 0500 PST Wind Direction NE-S	Max. Ozone at Pt. 2 O_3 (pphm)	Time (PST)
1						18.3	M	6	1629
2						21.4		10	0941
3		M			X	21.8	M	15	1041
4		M				18.1	M	22	1442
5	M	M				21.4	M	8	0951
6	M			X	X	23.0	X	M	
7					X	21.7	X	19	0957,1426
8						18.4	X	6	0526
9						19.8	X	3	0538
10		U				23.5	M	13	1553
11		O	X			24.5	M	26	1426
12	X	X		X	X	25.5	X	22	1442
13	X	X	X	X	X	25.6	X	M	
14		X		X	X	24.6		20	0954,1507
15		O		X	X	25.6	X	16	0936
16		X	M		X	24.4	X	27	0602
17		X		X	X	22.8	M	17	1431
18	M	X			X	22.1	X	34	1451
19	X	X				22.5	X	M	
20						21.2	X	8	0931
21						M	X	M	
22		M				14.8	X	4	1433
23						13.4	X	3	0557
24	M					13.2	M		
25	M					13.7	X		
26						7.9		6	1432
27						10.3	X		
28						10.2	X		
29		M				8.8			
30		M				6.3			

U = Maximum ozone 10-12 pphm
X = Maximum ozone > 12 pphm, or wind direction from NE-S
M = Missing data

3. All of the exceedance days when aircraft soundings were available showed high ozone concentrations (at least 15 pphm) at Pt. 2 (3 mi SSW of Laguna Peak). Peak values at Pt. 2 of 13 pphm or more were recorded on two non-exceedance days (September 4th and 10th) when maximum ozone concentrations in Ventura County were 12 and 11 pphm, respectively.

4. Maximum ozone concentrations of 10 pphm or more were observed at Laguna Peak on each day from September 10th to September 19th. An ozone exceedance occurred in the county on each of these days except for the 10th. All of these days also experienced high ozone offshore at Pt. 2. One occurrence of high ozone at Pt.2 (September 7th) was observed without a similarly high value at Laguna Peak. Presumably, the ozone layer remained offshore of Laguna Peak on that day.

Utilizing the results of the case studies, the occurrence of high ozone concentrations at Laguna Peak and Pt. 2, together with easterly winds at Pt. Mugu, should signify a contribution of South Coast Air Basin transport into Ventura County. This combination occurred from September 10th to 19th. A similar but less substantiated case can be made for possible transport on September 3rd, 4th and 7th where offshore concentrations were high but gaps in the remaining data existed.

High ozone concentrations at Ventura and El Rio in September 1983 occurred at the beginning of an extended period of warm temperatures aloft. This represented the early stage in the high pressure development when the offshore winds tended to reach their peak and mixing heights were relatively low. As the high pressure moved to the east, the mixing layers tended to deepen and the seabreeze was reestablished, with the inland areas usually receiving higher concentrations than the coastal sections.